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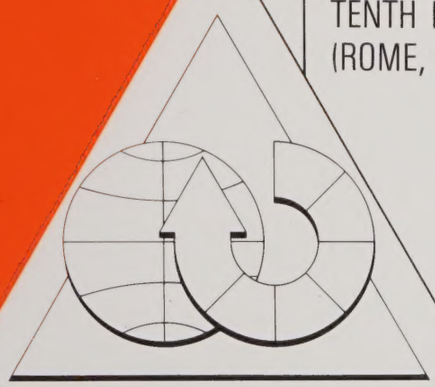
ANEL OF XPERTS ON NVIRONMENTAL MANAGEMENT FOR ECTOR CONTROL PEEM)

REPORT OF THE
NINTH MEETING
(GENEVA, 11-15 SEPTEMBER 1989)

REPORT OF THE
TENTH MEETING
(ROME, 3-7 SEPTEMBER 1990)



rt I: TECHNICAL DISCUSSION (1989) — Policies and programmes of governments, bilateral and multilateral agencies and development banks for environmental management.

rt II: TECHNICAL DISCUSSION (1990) — Livestock management and disease vector control.

rt III: GENERAL PROGRAMME AND POLICY

PEEM Secretariat
WORLD HEALTH ORGANIZATION
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Joint WHO/FAO/UNEP Panel of Experts on Environmental Management for Vector Control (PEEM)

Report of the ninth meeting
Geneva, 11-15 September 1989

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PEEM Secretariat
World Health Organization,
Geneva, 1991

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PREFACE

This document contains the reports of two meetings of the WHO/FAO/UNEP Panel of Experts on Environmental Management for Vector Control (PEEM): the ninth meeting, which was held at the headquarters of the World Health Organization in Geneva from 11 to 15 September 1989, and the tenth meeting, which was held at the headquarters of the Food and Agriculture Organization of the United Nations in Rome, from 3 to 7 September 1990.

The 1990-1991 biennium saw a great deal of change for PEEM and for its Secretariat. The Panel reviewed its original mandate, as contained in the Arrangements agreed on by the three agencies in 1981, and made recommendations for its revision and expansion. These were subsequently adopted by the agencies and agreement was reached on revised and updated Arrangements. On the basis of the new Arrangements the United Nations Centre for Human Settlements (Habitat) joined the three founding agencies in 1991. The text of the new Arrangements will be annexed to the report of the eleventh PEEM meeting.

With the disestablishment of the WHO Division of Vector Biology and Control in January 1990 the PEEM Secretariat was transferred to the Community Water Supply and Sanitation Unit in the Division of Environmental Health. This transfer occurred timely with respect to the updating of PEEM's mandate, and allowed for the incorporation of a water supply and sanitation element in the new Arrangements.

The Secretariat had to give first priority to the satisfactory completion of the above changes, and as a result the implementation of some items in the Panel's programme of work had to be postponed. This explains the delay in producing the reports of the ninth and tenth meetings. The background document prepared for the ninth technical discussion was, however, published in January 1990 as document VBC/89.7 and given wide distribution.

The report of the eleventh meeting will be published shortly and now that the frequency of Panel meetings has been reduced to once every two years, the Secretariat expects to return to its previous tradition of publishing the report within three months following a meeting.

Robert Bos
Secretary

Geneva, 1991

CONTENTS

PART I

TECHNICAL DISCUSSION
HELD DURING THE NINTH MEETING

POLICIES AND PROGRAMMES OF GOVERNMENTS, BILATERAL AND MULTILATERAL AGENCIES AND DEVELOPMENT BANKS FOR ENVIRONMENTAL MANAGEMENT IN THE CONTEXT OF NATURAL RESOURCES, AGRICULTURE AND HEALTH DEVELOPMENT[1]

The agenda of the ninth annual PEEM meeting included a two-day technical discussion on the above subject, which had been selected by the Panel's Steering Committee in 1988. In preparation for the discussion, inputs had been requested from a number of Panel members, concerning relevant policies and programmes of their Governments. The contributions received are listed in section 8. A consultant carried out a fact-finding mission to seven bilateral agencies, five multilateral agencies, four development banks or funds, and one non-governmental organization. In addition, the PEEM Secretary visited three bilateral agencies for interviews with key staff. Additional support for the preparatory work was received from the WHO Division of Vector Biology and Control and from the UNDP/World Bank/WHO Special Programme on Research and Training in Tropical Diseases (TDR), through its Steering Committee on Social and Economic Research.

All information was used in preparing a background document for the technical discussion. This contained chapters on policies and programmes of governments, of bilateral agencies, of multilateral agencies in the United Nations system and of multilateral development banks and funds. There were serious time constraints on the collection and analysis of material for the document, and the authors did not claim it as an integral and comprehensive policy review paper. However, the Panel considered it sufficiently important to recommend its publication as a separate PEEM document, after some indicated corrections and updates had been made.

The background document was therefore published by the PEEM Secretariat under reference VBC/89.7 at the beginning of 1990. The present report does not repeat the detailed information contained in that document; rather, it focuses on issues raised in the discussions themselves, and presents the Panel's conclusions and recommendations. It is therefore strongly advised that this report be read in conjunction with document VBC/89.7, which can be obtained on request from the PEEM Secretariat, World Health Organization, Geneva, Switzerland.

[1] Prepared by T.H. Mather, Water Resources Consultant, 8 Woodstock Close, Oxford OX2 8DB, United Kingdom

1. INTRODUCTION

Over the past ten years, several instances had been identified by the Panel where the lack of appropriate action had contributed to the introduction of vector-borne diseases, or to the degradation of an existing vector-borne disease situation, as a result of natural resources development projects. The absence of intersectoral planning, design and implementation procedures, the unavailability of sound forecasting, monitoring and surveillance techniques, insufficient research and development in innovative environmental engineering techniques, the use of inappropriate economic criteria in project appraisal, and the failure of tertiary education to transcend strict disciplinary boundaries were five key issues.

Underlying this lack of appropriate action was an absence of well-targeted policies. Policies existed at various levels to guide the decision-making in development processes. At the national level, a development plan might set broad goals and the policies to achieve these; the goals would be translated into specific sectoral objectives, with accompanying sectoral policies for their achievement. At the international level, development and funding agencies had their own policy frameworks. When it came to technical cooperation, these agencies and their policies were usually also organized on a sectoral basis.

Definitions adopted for the technical discussion included:

policy:	a course of action adopted by a government, party, etc. for the achievement of an objective.
strategy:	the allocation and deployment of resources in pursuit of the policy objective.
programme:	a definite plan of intended procedure.
project:	a scheme or undertaking.

In the formulation of sectoral policies, there was often little or no attention given to the impact they might have on the objectives and work of other sectors. This was particularly true for their possible effect on the environment and human health. Conventional economic thinking placed a high value on the immediate returns to capital investment in resource development projects, while discounting the costs of curative and corrective measures they might require in the future. There had therefore been little incentive in the past to review existing policies for their impact on what were considered less productive sectors, and to reformulate them with the avoidance of possible adverse effects in mind.

The report[1] of the World Commission on Environment and Development (WCED), which was published in 1987, had stimulated a fresh discussion of the fundamental concepts involved in the relationship between the use of resources for development and the degradation of the environment, including environmental determinants of the status of human health.

[1] World Commission on Environment and Development, 1987. Our Common Future. Oxford University Press.

It was against this background that the Panel decided to address policy matters in its technical discussion. The subject fell within the Panel's mandate, and it was one of the last broad areas that remained to be covered. It was intended, from its inception, that PEEM should disseminate its findings directly to the Member States, and that it should also try to give a high profile to its function as a coordinating body representing the three United Nations agencies. To achieve this, it should bring salient policy issues to the attention of the executive bodies of WHO, FAO and UNEP and, through these, try to improve the health and environmental components of government policies.

Policies and programmes of governments, dealt with in section 2 below, formed the most heterogeneous group, including: (1) policies and programmes of the sectors involved in natural resources development which may inadvertently affect human health; (2) health sector policies and programmes aimed at promoting the prevention or mitigation of adverse health effects of natural resources development; and (3) policies governing the negotiations with external financing agencies for those development projects that cannot be funded from internal or local capital.

The successful promotion of environmental management for vector control depends on persuading financing bodies of the desirability of expending resources on such measures. Similarly, the proper consideration of health aspects in development projects (allied to the incorporation of environmental management measures) is dependent on the adjustment and effective implementation of sectoral policies and funding at various levels. In the translation of environmental concern into action, policy change may become a major hurdle. Existing policy statements, expressed in terms of short-term project results and benefits, might impede a shift toward more broadly based, longer-term management, funding and monitoring, essential when dealing with the environmental and health impacts of natural resources developments. Another important factor, the rapid turnover of key staff in bilateral and multilateral agencies, also worked against the development of a corporate memory and the formulation of policies with a broad time horizon.

In the light of the above, the Panel's discussion had, as objectives, the collection of information relevant to the subject; the analysis of this information; the identification of knowledge gaps in the technical areas related to the interfaces of agriculture, natural resources development, the environment and human health, which hampered the formulation of policies to cope with the problems; and the identification of missing or incongruent policies which resulted in sectoral actions with adverse impacts on health.

In the following sections, government policies and programmes for development set the scene for the negotiations with external support agencies, each of these in turn, whether bilateral or multilateral, whether development agency or funding agency, bringing its own set of policies into the interaction.

2. POLICIES AND PROGRAMMES OF GOVERNMENTS

The Panel's discussions on government policies and programmes included five country-specific presentations (Egypt, India, Nigeria, the Philippines and the United States of America) and two regional overviews (Eastern Mediterranean and the Ameri-

cas). For case studies on Egypt, India and the Philippines, reference is also made to document VBC/89.7.

General agricultural policies

In Egypt, agricultural production was mainly dependent on irrigation, and this was facilitated by the construction of the Aswan dam in 1902, and the Aswan High dam in 1964. Water availability and water quality had now, however, become major constraints. The population of Egypt was expected to grow from 52 million now to 70 million by the year 2000, and this had led to considerably increased pressure on agricultural production. Already, 40% of all food requirements, and indeed 60% of Egypt's wheat consumption, had to be imported. This gap between local supply and demand had required a substantial revision of agricultural policy, and the Government now promoted two types of expansion: vertical expansion for a higher yield per hectare, and horizontal expansion in the form of developing new lands. The first included the introduction of high-yielding crop varieties, improved fertilizer application and restructuring of the cooperative system. For the second type, water - not land - was the constraining factor. It was therefore linked to programmes for the better management of water and the improved efficiency of its use.

The problem of waterlogging had already taken on serious dimensions in the 1950s, and a programme was started, supported by the World Bank and bilateral donors, for an extensive field drainage network. This, and a programme for canal lining and improved canal maintenance, were likely to have had a beneficial effect on reducing the environmental conditions that favour vector-borne disease transmission.

The use of wastewater and the development of groundwater resources had a great potential in supporting horizontal expansion. The Government had been careful in formulating a policy on wastewater use, precisely because it recognized the potential environmental and health risks involved. Groundwater from shallow depths was also liable to contamination, and the Ministry of Irrigation had therefore set standards for the digging of wells, to counter this problem.

Aquatic weeds had become a major problem in the irrigation systems, and their presence also constituted a health hazard. Many weeds provided a good substrate for freshwater snails, and their excessive presence slowed down water flow, thus contributing to the creation of favourable snail habitats. Weed control could be carried out manually (with an inherent risk of schistosomiasis for the workers), mechanically, chemically or biologically. The Ministry of Irrigation had established policies toward the reduction of the use of chemicals, and the emphasis was therefore on the other three methods.

There were no national policies which aimed at promoting intersectoral collaboration in the prevention and control of diseases associated with water resources development. The bilateral and multilateral agencies that gave financial support to many programmes in Egypt could play an important role by assisting in this respect.

Irrigation development was also one of the fundamental components of India's agricultural production. An expansion of the area under irrigation from 68 to 113.5

million hectares was foreseen by the year 2000. The National Water Policy stated:

Project planning for the development of water resources should, as far as possible, be for multiple benefits based on an integrated and multidisciplinary approach, having regard to human and ecological aspects and special needs of disadvantaged sections of society. Maintenance, modernization and the safety of structures should be ensured through proper organizational arrangements.

In reality, health aspects were largely ignored, and whatever measures were taken that resulted in health benefits had other primary goals, such as the reduction of water-logging and the improvement of soils.

The Government aimed to achieve an equitable distribution of irrigation water, and had adopted a policy of rotational releases of water. The resulting 4-6 week intervals between releases left enough time for pool formation in the canals, and the consequent breeding of the main malaria vector *Anopheles culicifacies*. This was an example of a well-intended policy with unforeseen adverse effects.

There was a lack of policies aimed at regulating the movement of agricultural labourers to new development zones, and for the provision of health services for permanent settlers and for seasonal labourers.

With respect to the use of insecticides, the Government of India had responded to the well-known phenomenon that their indiscriminate application for agricultural purposes led to induced resistance in disease vectors. It had banned DDT for agricultural purposes, and had reserved 10 000 tonnes for public health use. A similar policy, adopted in the past by Sri Lanka for malathion, had given rise to an illegal trade in the insecticide at the farmer level. For easier control of such practices, the Indian Government had decided to mix a colour additive in the DDT.

The links between traditional rice production systems and malaria were not always well established, but the past decade had witnessed an active promotion of new crop varieties by the Government. This policy had been successful, and in many parts of India rice was now harvested twice, or even three times annually. There had, however, also been serious outbreaks of malaria and Japanese encephalitis, whose origins could be traced back to related changes in agricultural practices.

Certain animal species played an essential role in maintaining the ecological balance of disease vectors, and insectivorous amphibians were among them. An increased demand on the world market for frogs had led to growing exports and a rapid reduction of frog populations in some parts of India. Malaria outbreaks in those areas were blamed on the disruption of the ecological balance. As a result, the Government of India banned the export of frogs.

In its discussion of the various issues raised by the presentations at the meeting and in the background document, which gave additional information on Sri Lanka, Ethiopia, Kenya, Thailand, Brazil and the Lower Mekong Basin, the Panel stressed the need to revise inconsistent pricing and subsidy policies with implications for natural resources development and management running contrary to good environmental and

health practices. Environmental and health aspects, now commonly considered as externalities, should be integrated into the agricultural production process, and the cost of correcting negative impacts should be reflected in the price of products. Multilateral and bilateral assistance targeted at reducing such problems was of value as short-term relief, but did not provide a sustainable solution.

Several Panel members emphasized the growing importance of wastewater use for agriculture and aquaculture. In Egypt, the use of wastewater from the city of Alexandria was under study. In India, a plan had been launched for the treatment of municipal wastewater before discharging it into the Ganges. The particular vector-borne disease implications of wastewater treatment and use deserved special attention at a future Panel meeting.

It was noted that in Egypt a number of control projects had been successful, and the Panel asked whether there were any impediments to pursuing this further, and to carrying out research into fresh strategies. In response it was indicated that the Water Research Centre in Cairo, with its eleven associate institutions, was in the process of reviewing its research policies and incorporating an environmental element, with support from UNDP. The Panel would consider the possibility of in-depth policy studies to be carried out in Egypt, through the Centre.

In India, there seemed room for retrospective studies of policies that were applied before the DDT era, but had since been abandoned. Such a review could perhaps help strengthen the case for attention to vector-borne diseases, which were not at present included in the clearance procedures for water resources development as carried out by the Department of the Environment.

Regarding the bans on the agricultural use of DDT in India, of malathion and fenitrothion in Sri Lanka, and the export bans on certain species such as frogs, the Panel stressed the need for such measures to be based on sound scientific evidence, if they were to be of lasting effect, and also to establish their credibility for any future application.

Canal lining had often been proposed as an important environmental management measure to prevent water loss through seepage, and subsequent vector breeding. Recent studies in the Punjab, however, had shown that over a period of four years the linings deteriorated to a point where water savings became very small. The policy to promote canal lining was therefore questionable on grounds of cost-effectiveness. There were also contradictory reports concerning water management practices such as intermittent irrigation. From the India case study, it was clear that certain rotational schemes for water release may promote vector breeding. From earlier work in rice fields in China, probably on soils with different characteristics, the opposite could be concluded. A related technique, using flushing devices, in Malaysia and in Sri Lanka, had played an important role in malaria control. The Panel felt that these examples illustrated the need for more pilot projects on the effectiveness of different water measures in terms of disease vector control in various ecological settings, to provide a better technical basis for the formulation of irrigation design and management policies.

Environmental impact assessment policies

The concept of environmental impact assessment (EIA), had been developed in the industrialized countries, but had now become mandatory for proposals for major natural resources development projects in many non-industrialized countries. Case studies from the Philippines and Thailand were reviewed by the Panel, and a presentation was made on the policy aspects of EIA in the Americas.

In Thailand, the 1975 Act for the Improvement and Conservation of Environmental Quality made EIA obligatory for projects meeting certain criteria, and the environmental impact statement needed acceptance by the National Environmental Board before project implementation could start. Two major problems arose: the lack of experienced scientific and technical staff who could carry out the work as required by the terms of reference, and the inadequate follow-up of recommendations made on the basis of the EIA. Often, no funds had been allotted for this in the overall project budget. This was particularly true for the incorporation of health protective measures.

Such problems existed also in the Philippines. When the EIA system became effective in the late 1970s, the (then) National Environmental Protection Council received a considerable number of applications. Their numbers declined over the following years, mainly because of the increasing proportion of exemptions granted. In those cases where an EIA was carried out, funds for this component of the feasibility study were usually so limited that the outcome was little more than lip service to government requirements. The implementation of any resulting recommendations was hampered by the fact that the Environmental Management Bureau had a lower status in the administrative system than most of the executive agencies involved in project development. Public participation in the assessment was another weak point. The regulatory agency discouraged the participation in the planning process of the population affected by a project. Of 5000 approved applications for EIA, a public hearing was organized in only two cases.

In the Americas, the Pan-American Health Organization (PAHO) directed its policies toward the goal of developing an approach to assess risk factors in absolute terms, based on the measurement of attributable or relative risks. Through its Regional Centres, among which is the Pan-American Centre for Human Ecology, in Mexico, it was collecting case study material for analysis and presentation to decision makers in a format that would be meaningful to them and to planners. Their education across the usual strict disciplinary boundaries was an important facilitating factor. As a major output of this approach, it was expected that policies would be modified to focus on decentralization and the strengthening of local health services.

Technical cooperation with countries in the Americas, in support of environmental impact assessment, consisted of: resource mobilization, information collection and dissemination, intersectoral planning, improved research and training programmes, and the promotion of technical cooperation among countries of the region.

The methodologies involved in EIA covered standard epidemiology, including the determination of risk factors; a review of managerial processes in the health services; the integration of ecological and epidemiological changes; and cost-effectiveness and

cost-benefit analyses. In brief, the final objective was to match disease prevention and control programmes which took no account of environmental risk factors, with resource development projects that affected such factors but did not consider their health implications.

In its subsequent discussion, the Panel debated at length the issue of public participation in EIA. Clearly, a first condition for participatory approaches to EIAs was that there must be a solid public information base, and this in turn required improved education and information systems. It was often the case that government agencies, under political pressure to produce projects with short term economic returns, actually restricted access to vital information and excluded communities from participating. It could be hoped that the current global increase of environmental awareness would lay the foundation for improved and informed community involvement. Politicians should respond to these developments, and not underestimate the role of public opinion in this connection. Several Panel members had experience of a similar sort in their contacts with multilateral and bilateral donors. Access to information on the adverse aspects of development projects was difficult, and proposals to carry out *ex post* assessments of environmental impacts were usually unwelcome.

At the level of education and training for professionals responsible for decision-making on development projects, a number of courses were listed. The long-standing course on environmental impact assessment organized jointly by Aberdeen University and the WHO Regional Office for Europe had, over the past decade, trained a considerable number of people from developing countries. In the Region of the Americas, the Pan-American Centre for Human Ecology in Mexico had made important contributions to the promotion of EIA and, in many UNDP country projects, training components had focused on EIA. Increasingly, universities were offering diploma courses in EIA, one of them recently established at Imperial College, London. In the training curricula developed under the auspices of the African Conference of Ministers of the Environment, EIA formed a vital component. Generally, though, training tended to highlight methodological issues, and there was an opportunity for PEEM to try to promote the policy aspects in the context of such courses.

The picture presented in the background document and in the foregoing presentations was complemented by a contribution from the Panel member from Nigeria. Since many countries in sub-Saharan Africa were at a different stage of development from those mentioned so far, it was considered useful to review their perspective.

In Nigeria, there was a total of nine national policies in place, on, *inter alia*, agriculture, health, and science and technology. Within their frameworks, several policy statements had been formulated. These statements were supposedly the guidelines for decision making procedures but, in practice and until they were backed up by legislation, they were mere statements of intent.

This held true for environmental policies as well; a national policy on the environment had been introduced in 1988. Many government officials in key economic sectors such as agriculture continued to perceive environmental considerations as obstacles to their sectoral goals. As part of the new procedures, however, all proposals were now evaluated and ranked for their relevance to the national development plan, and the

Central Planning Office, in charge of this procedure, organized public hearings and subsequently prepared its final recommendations. There were good prospects to include an environmental and health impact assessment in this procedure.

An approved proposal would then be channelled for external support to UNDP or the World Bank, for example, which would in many cases carry out an independent appraisal. The terms of reference of the appraisal mission might or might not include any environmental or health impact assessments, and in practice it often depended on individual members of a mission whether these issues were addressed. Past experience had taught that, despite the policies of development agencies, the incorporation of health safeguards was the exception rather than the rule.

Finally, of interest and of considerable potential in this connection, was the revenue allocation policy adopted by the Government of Nigeria in 1983. This set aside 1% of the national revenue to solve ecological problems. While this policy, at present, appeared to serve only the agricultural sector, there would be scope for similar benefit to the health sector. This would require, in the first instance, that the national health sector give a higher profile to the environmental determinants of health. There would be a role for PEEM to promote this issue at the national level, and to assist the Ministry of Health in achieving a better recognition of the health dimension of environmental problems.

Policy changes and policy conflicts

As national and regional priorities changed, so did policies, and there must therefore always be a provision for their reconsideration and modification. Sometimes, though, the acute problems that led to the original priority setting might have become latent rather than have disappeared completely, and while public awareness and political pressure favoured a policy change, the original goals of such policies should not be ignored.

This was well illustrated by the water management policies established by the Tennessee Valley Authority (TVA) in the 1930s. The standards of mosquito control maintained by TVA equalled those maintained in privately owned river impoundments under prevailing public health regulations. The measures included the programmed fluctuation of water levels in the reservoirs, a practice that played a key role in reducing *Anopheles* populations and eradicating malaria transmission in the Valley.

New uses of the reservoirs, including recreation and the promotion of nature conservation, had led to a conflict of interests. For recreation, stable water levels during summer and early autumn were required; conservation of certain fish species and of waterfowl required higher water levels in spring to promote fish spawning and the rapid growth of aquatic vegetation for the fowl. The changes in water management regimes would without doubt result in increased mosquito populations, yet the potential risk for the re-introduction of vector-borne disease was not appreciated to its full extent after three generations of malaria-free experience.

In recent years, much interest had been directed toward the protection and establishment of wetlands, without paying sufficient attention to their mosquito breeding potential. Consequently, TVA had been faced with a conflict of new policy directives concerning wetlands, existing mosquito-control policies, and state regulations for impounded water. The use of constructed (artificial) wetlands for the treatment of domestic wastewater and its processing for reuse was of particular concern, since these could produce large quantities of potential disease vectors, and they were often sited close to populated areas.

The Panel considered the recent developments in the United States, with respect to agricultural and environmental policies in some detail, in the awareness that policy changes and new legislation in that country often set the trend and served as a model for similar developments in other parts of the world. It was noted that vector control in the United States had lost its importance as an issue at the national level, and responsibility for vector control operations had been devolved entirely to the state, or even local government level. As a result, vector control operations were not likely to be taken into account adequately in the formulation of new national policies.

Of the current agricultural policies in the United States, two were of particular importance in relation to disease vector control activities. The Production Control Policy regulated the agricultural land use patterns, including land management, crop and livestock rotation and water use. These patterns and practices influenced vector breeding habitats in quality and quantity, and their spatial distribution. Information on the dynamics of land-use and agricultural practices was usually not readily available to vector control agencies, with the result that they could not introduce appropriate, timely adjustments to their programmes.

The other group of relevant agricultural policies was that of the Food Safety Policies. It was becoming increasingly clear that these policies would lead to a substantial replacement of chemical pesticides with non-chemical pest control measures, a development which might have important repercussions for vector control programmes. Alternative strategies were usually more expensive, and often required additional training of technical staff.

The agricultural policies were supported by appropriate legislation such as the Food Security Act, popularly known as the Farm Bill. This Act was broken down by commodity, and dealt with agricultural production issues almost exclusively on the basis of economic parameters. Only sections XII (conservation, especially wetlands conservation), XIV (agricultural research, extension and training) and XVII (related and miscellaneous matters) were of particular importance to disease vector control, and of these section XIV was the only one expressly to mention the subject. It was, nevertheless, on the basis of this section that the USDA-supported Riceland Mosquito Management Programme (RMMP) had been initiated.

Environmental protection and nature conservation policies had affected pest control in the United States to an important degree over the past 10-15 years. At the centre of recent reforms was the Federal Insecticide, Fungicide and Rodenticide Act, which was amended by the Federal Environmental Pesticides Control Act in 1972. The amendment had had a considerable positive influence on pesticide use, illustrated by the fact

that the number of vector control programmes relying exclusively on pesticides had been greatly reduced. On the negative side, the costs of gathering the environmental safety data required for the approval of any new compound by the Environmental Protection Agency had depressed the incentive for the development of new products for the already limited vector control market. Rising costs of vector control programmes, resulting from adjustments enforced by environmental laws, had also contributed to the suspension of a number of such programmes, and to the reduction of the scope of others. This trend might continue under the new Endangered Species Act, which would introduce pesticide label restrictions to prevent their use in areas within the distribution range of endangered species. In response to this development, the American Mosquito Control Association (AMCA) had developed a model Public Health Exemption Plan which it was hoped would relieve some of the potential problems that the enforcement of the Act might have on vector control.

The Panel noted that two important conclusions could be drawn from the review of policy changes and policy conflicts in the United States. First, the need for public awareness and participation in policy formulation and implementation, mentioned earlier, was once again emphasized. Secondly, it was clear that the trend toward integrated management of agricultural pests, already apparent in the United States, would increasingly dominate the picture in developing countries. The effects of policy and legislation on the promotion of integrated pest management (IPM), would be felt indirectly in the strategies for disease vector control, and it was therefore highly important to encourage collaboration among the responsible national organizations. PEEM could be instrumental in this by further strengthening its contacts with the FAO/UNEP Expert Panel on Integrated Pest Management. This should be done through the secretariats of both agencies, and possibilities for formulating joint strategies should be actively explored. Wherever PEEM Collaborating Centres were active in the area of IPM (for example, IPM is a major component in the work plan of the International Rice Research Institute), the incorporation of vector control aspects within such activities should be explored and promoted where appropriate.

3. POLICIES AND PROGRAMMES OF BILATERAL AGENCIES

The Panel's discussion on the policies and programmes of bilateral agencies was based on a review of eleven such agencies, presented in the background document VBC/89.7, and on two presentations by bilateral agency observers representing USAID and Danida.

Governments of the 18 richest countries supplied some 80% of official development assistance funds, with 60% channelled through bilateral assistance and the remainder through multilateral agencies. Bilateral assistance was in the form of loans or grants, with recent trends being toward an increase in grant aid.

Policies and programmes of the bilateral agencies differed from country to country, but they had a number of common characteristics, listed in Table 1. The stated fundamental goals of bilateral assistance invariably included the relief of poverty, the sustainable use of natural resources and the protection of the environment.

TABLE 1. BILATERAL ASSISTANCE

CHARACTERISTICS OF OPERATION

(In the table, 1 indicates a significant issue for the agency, 2 indicates a minor issue, blank is inadequate information)	Belgium ABOS	Canada CIDA	Canada IDRC	Denmark DANIDA	Fed. Rep. Germany GTZ	Netherlands DGIS	Italy DGCS	Japan JICA	Sweden SIDA	UK ODA	USA USAID
1. Part of OD aid through											
a) bilateral programme	1	1	1	1	1	1	1	1	1	1	1
b) multilateral programme	1	1	2	1	1	1	1	1	1	1	1
2. Concentration on "programme countries" for bilateral aid	2	1	2	1	-	1	1	-	1	-	-
3. Existing policies or strategies on											
● natural resources development	-	1	2	1	-	1	1	-	1	-	1
● environment	-	1	2	1	-	1	2	-	2	1	1
● health	1	-	2	1	-	1	1	-	1	-	1
4. Implementing field programmes on											
● natural resources development	1	1	2	1	1	1	1	1	1	1	1
● environment	-	1	2	2	-	1	2	-	1	2	1
● health	1	1	2	2	1	1	1	2	2	2	1
5. Agency guidelines for development cover											
● environment	-	1	-	1	-	1	-	-	-	1	1
● health	-	-	-	1	-	-	-	-	1	-	1
6. Requirement for environmental impact studies	-	1	-	1	1	1	-	-	2	2	1
7. Desk officers located in a) HQ	1	1	1	1	1	1	1	1	1	1	1
b) region or country	-	1	2	1	-	2	1	1	1	2	1
8. Technical support staff a) agency direct	1	1	1	1	1	1	1	1	1	1	1
b) sub-contracted	1	1	1	1	1	1	1	-	1	1	1
c) host country	-	1	1	1	-	-	1	-	1	1	1
d) home NGOs	1	1	-	1	1	1	1	-	1	2	1
e) other NGOs	-	-	1	2	-	-	2	-	2	-	1
9. Project evaluation process	-	1	1	1	-	-	1	-	1	1	1

Two features of bilateral agencies were particularly relevant in the context of this technical discussion. First, there was a great deal of concern that the funds at their disposal should, in so far as possible, be spent on project activities in the target countries. In programme reviews of the Development Assistance Committee (DAC) of the Organization for Economic Development and Cooperation (OECD), the percentage of development assistance funds spent on overhead costs was a critical evaluation criterion. The pressure to reduce these costs had led to decentralization and to a decrease in headquarters desk officers and technical advisers. Secondly, the personnel situation in most bilateral agencies was characterized by a high turnover. This might be the result of a policy of rotation enforced by ministries of foreign affairs, to which the agencies often belonged administratively; in some cases, it might also reflect less satisfactory career prospects in the technical assistance sector.

To provide the necessary technical backstopping of country projects, a variety of sub-contracting arrangements had evolved; with private consultancy firms, with national or semi-governmental institutions, or with universities and other institutes of tertiary education.

The above developments indicated a growing need, within the bilateral agencies, for the provision of technical and administrative skills to draft terms of reference and contractual formalities; to supervise the implementation of projects; and to assess results. At the same time, there had been a serious loss of agency experience in the sub-contracted areas, with a decline in ''corporate memory'' related to the technical content.

The growing concern for the environment, and particularly the relationship between environment and development, had had an important impact on the policies and programmes of bilateral agencies. The report of the World Commission on Environment and Development had provided a major stimulus for policy review and formulation, especially through its recommendations on required changes in attitude and perceptions of the international community with respect to the environmental issues at stake in overall development, and on the changes needed in the relationships between countries at different stages of economic and social development, in promoting their common concern for the protection of the environment.

In response to this, most agencies had developed environmental guidelines suited to their particular institutional and programme needs. Such guidelines reflected the policy, enforced by most agencies, that proposals for natural resources development projects submitted for their support required some form of environmental impact assessment.

Some agencies had already gone further and were, for instance, developing environmental profiles of countries or regions specifically targeted for their assistance efforts.

The link between the environment and human health had not had a high profile in the current wave of environmental concern. It had, in general, been rather taken for granted that the promotion of environmental protection and improvement would have inherent health benefits. It was, however, only fair to mention the notable exceptions of USAID and DANIDA in this respect, and also the efforts of health representatives in

the Italian Ministry of External Affairs in their initiatives to have health issues incorporated in OECD development aid processes.

The bilateral agencies were recognized as having a rather distinctive approach to development assistance, when compared with multilateral agencies. This arose from their normal contact and entry points to recipient governments being through ministries of foreign affairs, in contrast to a commonly sectoral association in the case of the multilaterals, as for example the ministry of agriculture for FAO and the ministry of health for WHO. They were not therefore sectorally aligned from the outset of any negotiations, although a number of the donor countries did prefer to operate in sectoral development areas which matched their national expertise and interest. In the case of USAID, with its large and complex structure, policy papers had been published by different offices and bureaux on various sectors, and in each of these one could find language giving either explicit or implicit support for environmental management activities - even in some cases specifically for environmental management for vector control.

The USAID bureau for policy and planning coordination prepared annual development strategy statements for each of the countries selected for support, which might offer a window of opportunity for PEEM to introduce appropriate comments. All USAID supported projects required some form of EIA and, in the case of multidonor projects where USAID was a partner, the establishment of a joint donor and host country technical committee was required, with responsibility for addressing the environmental impacts and for stating measures for the inclusion of environmental management in the project. Where the project was a simple bilateral operation, federal regulations also called for an ''initial environmental examination'' to identify potential environmental impacts of the project and, briefly, to list mitigation measures. Decisions on whether to call for a more complex environmental impact statement were made at regional level and accompanied the summary project paper, setting out the overall technical, economic etc. benefits and impacts. This process appeared to offer ample opportunity to include environmental management proposals, but there was always the possibility that ''overriding considerations'' of economic or security issues might weaken or overrule the environmental proposals.

The existence of regulations relating to environmental issues was common to most of the bilateral agencies, but equally common was the problem of their enforcement, especially in the long-term context of many natural resources development projects, when there was a continuing need for monitoring and the mitigation of environmental and health impacts long after the project development cycle. The establishment of trust funds to support such measures was proposed as a promising approach to this problem. The question was raised of a narrowly-focused economic appraisal as a possible constraint on the inclusion of environmental management measures within a project. This prompted suggestions for the incorporation of health costs in the economic equation; the extension of the project horizon and the cost-benefit stream; the use of a cost-effectiveness analysis; and also the acquisition of good *ex post* cost-benefit data over a 10-20 year period for major natural resources development projects, for analysis and use as a tool for future project appraisal.

The bureaucratic complexity of larger bilateral agencies, usually following typical academic and disciplinary lines, was also cited as an impediment to the intersectoral approaches needed to such issues as the alleviation of hunger and malnutrition; the improvement of goods and services; and environmental management. There was seen to be a strong need to establish linkages between the various departments and offices. For instance, in the USAID, the agricultural bureau, with specific responsibility for integrated pest management programmes, defined pests in narrow terms of their effect on crops and produce. A broader definition would allow the inclusion of human disease vectors.

The representative of DANIDA concurred with the comments of other participants, but also stressed the importance of building up the ability and skills of the host country in the development and management of natural resources projects and their environmental and health aspects. He cited the involvement of the target population in project preparation; strengthening the administrative capacity of local institutions; ensuring access of the population to resources; the provision of short-term benefits in long-term environmental projects; and the need to incorporate flexibility in project implementation to allow for changes if unforeseen environmental consequences arose. Certain of these approaches would call for changes in host government policies, and this was an area that bilateral agencies might not be able to influence directly. It was suggested that such influence could best be applied through the medium of appropriate multilateral agencies of the United Nations system, where all the bilateral donor countries had a voice.

In view of the scale of bilaterally-supported activities in natural resources development, their potential environmental and health impacts, and the constraints faced by the bilateral agencies and the host governments in giving due attention to such problems, it was felt incumbent on the Panel to review possible areas and methods for assistance to these programmes. One area was the production and dissemination of information in the form of PEEM newsletters, technical documents, consultant lists and briefing packages. While accepting this in principle, various comments suggested that the targeting of PEEM material could be greatly improved. It might be that contacts made in respect of the technical discussion would offer some opportunity for this, but there was a clear need for better identification of offices and individuals who could benefit from the documentation, and who could also participate in the promotion of environmental management activities for vector control.

Various agencies had prepared, or were preparing environmental guidelines, some of which included specific environmental management methods for vector control, but there was no known handbook of measures for the mitigation of environmental problems in different types of projects. Such a handbook could well incorporate environmental management methods, and serve as a reference for agencies' desk officers.

Together with the attention to be given to the further production and improved targeting of information, the Panel recognized the need to address the wide range of disciplines and backgrounds of those involved in the implementation of bilateral programmes, and made a plea for the preparation of material in "layman's language".

The Panel was then given a general overview of the policies and processes of official development assistance. Taking the OECD, 18 governments provided 80% of total world aid, and of this 40% was routed through multilateral organizations and development banks, while 60% was in direct bilateral assistance to countries selected by national parliaments for reasons of tradition, trade, politics and other vested interests. For the Panel to influence any decisions on bilateral programmes, a direct approach to the DAC, for example, was not likely to be effective. An approach through national sponsors, inside the Committee, offered some chance of success, but there were two essential requirements. First, the area of concern must be sufficiently broad in terms of its environmental and health content to justify consideration (the implication being that vector-borne diseases would form only a component of such an area); secondly, and of great importance, it must be shown that the participating agencies themselves (WHO/FAO/UNEP) had a coordinated approach and were fully committed to work together in a common concern for the environment and health. It was especially in this second capacity that the Panel could have a real role to play.

4. POLICIES AND PROGRAMMES OF MULTILATERAL AGENCIES

The study of multilateral agencies of the United Nations system covered the three participating organizations of PEEM, (WHO/FAO/UNEP) and also UNDP, UNICEF, and the World Food Programme. The programmes and activities of all these agencies reflected their responses to the needs and requests of their member states, expressed in general by their national representatives in the governing bodies of the agencies and, in more specific development project terms, by the national sectoral departments. Issues of environmental concern and human health, where considered in national development programmes, had at best been marginal to the primary objectives and had become apparent mainly during the two or three years preceding the present technical discussion.

Most of the multilateral agencies had introduced health and environmental aspects into their own regular programmes in recent years, but they had not often been picked up in terms of requests for activities in member states. The aim of the background paper was therefore to try to anticipate what might be future demands onthe United Nations system in these areas of study and support and, more particularly, to assess the ability of the agencies to incorporate environmental and health components in their support to national development processes.

In general, it was true to say that these abilities were very limited. While most agencies could point to statements and resolutions regarding their positive attitudes toward the application of environmental and health criteria in their development procedures and processes, they had few staff who were well informed on these aspects, except in specific areas such as natural resources conservation, for example deforestation, soil conservation and water pollution, and in specific disease control activities. Agency programmes showed little coherence in linking environment, health and development.

In fairness to PEEM, it should be said that its past work and the efforts of its members had made an impression on a number of agencies as to the need for intersectoral collaboration and the necessity at least for an awareness of the activities of sectoral

agencies and their impacts on each others' fields of operation and responsibility. Examples were given of successful interagency collaboration in field programmes and projects, as had happened in Ethiopia, but such cases were still something of an exception. In common with the bilateral agencies, movement and changes of staff also took their toll of corporate knowledge in the technical and operational units of the multilaterals. If an acceptable level of awareness and knowledge of environment and health aspects of development was to be maintained, this would require a continuing process of education and information for agencies' staff, as new personnel took on responsibilities for development programmes and activities.

This raised the question of introducing the issues of health and environment at a sufficiently early stage to be incorporated in the national context, in short, at the stage of project formulation. Major responsibility for national development programmes within the United Nations system rested with UNDP, which determined the funds to be allocated and the involvement of the specialized agencies. UNDP, with its stated coordination role, was therefore best placed to ensure that project formulation should give consideration to any potential environmental or health impacts of a proposed development. It was evident that the UNDP desk officers were generally unaware of such issues. They were not therefore in a position to determine the need for studies or measures to assess or to mitigate adverse impacts of development, and the current guidelines for project formulation were totally inadequate as a source of information and advice in this area.

There was also recognition of the problems generated by the specialized agencies themselves, as a result of their tendency to a dispersal and diffusion of interests within sectoral programmes. As an example, there was concern that PEEM itself risked being seen as an isolated initiative, rather than as a component within a necessary broader and more comprehensive package for environmental and health concerns in development.

This point was further elaborated by references to the European Region of WHO where, it was claimed, there had been close contact between programmes for health in relation to industry, transport and energy, and within recent years this had begun to extend to agriculture, where there were many health concerns other than those posed by disease transmission by vectors. It was also suggested that the concept of disease vectors was not broadly understood, and that PEEM emphasis on the word "vector" might be a deterrent to the promotion of its activities.

The process of project formulation was again raised in the national context where, it was stressed, the sectoral origins of projects virtually precluded any health or environmental component in government proposals which might deliberately omit any elements that threatened to divert attention and funds from the primary objectives. There was therefore an appeal to PEEM to encourage UNDP to take a lead in the preparation of guidelines for the incorporation of these components where there were potential hazards to health and the environment. The benefits of such comprehensive guidelines would extend beyond the UNDP programme, as they would serve also in the cases of bilateral trust fund projects and those funded from other sources.

In response, a representative of UNDP informed the Panel that an analysis of all ongoing projects, approximately 5 000, was being carried out to ascertain the environ-

mental component, and to assess environmental impacts. Also, UNDP was trying to utilize the DOEM, (designated officials in environmental matters), which for more than a decade had comprised representatives of all organizations in the United Nations system in an attempt to integrate environmental issues into planning. The continuation of the DOEM, which had an intended coordinating function, depended on some early proof of its effectiveness.

In addition, UNDP and UNEP were working on a pilot project for three countries in different regions to study the integration of environment into planning. Regional meetings of UNDP resident representatives were informed of the environmental issues, and an attempt was being made to sensitize them to such concerns, as a part of a necessary educational process for the staff. But the two agencies also recognized the need for awareness on the part of recipient governments, and the establishment of national focal points and a national will to incorporate environmental concerns. Without these commitments, UNDP efforts could not be effective, as it was primarily a government responsibility to carry out and coordinate the relevant activities in the country. It was agreed, though, that the preparation of project formulation guidelines linking the environment and human health with development was desirable, although it formed only one facet of the introduction and implementation of these features in national programmes.

The Panel was informed of the structures, policies, processes and resulting resolutions and programmes of WHO associated with health and environment in natural resources development, in particular those for the control of vector-borne diseases in water-related activities. The past nine years of PEEM had seen many practical examples, and it was now important to view the possible expansion of efforts through the more general concept of intersectoral action for health, the subject of an 1986 World Health Assembly resolution. In the formulation of this resolution, WHO-sponsored technical discussions involving FAO and ministers of health had been convened on the relationship between agriculture and health, and also on environment and health, in collaboration with UNEP. A third group was sponsored by the United Nations, with ministers of finance, and another cosponsored by UNESCO and attended by representatives of ministries of education, culture and information. Current approaches, aimed at the incorporation of health status as a part of development activities, involved close collaboration with the World Bank and related to industrialization, urbanization and agriculture, and the formulation of appropriate policy options[1].

The programme elements of FAO in relation to health and environment in agriculture, were presented and the Panel was informed of a current initiative of the Organization in preparing a paper on water and sustainable agricultural development, which had a strong environmental theme together with bearing on human health status. This formed a preparatory activity toward the United Nations Conference on Environment and Development (UNCED), in 1992. Similarly, UNEP drew attention to UNCED, noting that this should be a relevant forum for the presentation of PEEM programmes and proposals, and suggested that an effort be made to provide contributions to the Conference.

In further comments on inputs to UNCED, the Director of the Environmental Health Division of WHO stressed the increased emphasis now placed by the Organization on

[1] This collaboration resulted in the publication, in 1991, of *The Impact of Development Policies on Health*, a review of the literature by D.E. Cooper Weil, A.P. Alicbusan, J.F. Wilson, M.R. Reich and D.J. Bradley (WHO, Geneva)

the integration of environment, health and development in its programmes, noting the drafting of a new global strategy which would draw on the knowledge of in-house divisions and WHO regional offices, and also on the experience of multilateral and bilateral organizations and member states. There was a proposal to convene a commission on health and the environment[1] to make an inventory of what was known and of gaps in this knowledge requiring further research. Referring to the World Commission on Environment and Development, the valuable content of its report was acknowledged, but it was evident that the absence of a clear health dimension indicated the existence of serious gaps in the perception of the problem, which called for WHO and interagency collaboration through their collaborating centres and panels. Areas already receiving attention, but demanding even greater effort, were those of water supply and sanitation and of water resources management, currently giving rise to acute concern in both developing and industrialized countries.

Presenting a bilateral agency's view of the multilateral agencies' role, the representative of DANIDA thought that bilateral funds might be increasingly directed through multilateral programmes, where environmental and health activities were involved. It was therefore incumbent on the United Nations system to take a lead in setting out suitable guidelines and criteria for environmental studies and assessments in suchcollaborative undertakings. When it came to specific issues such as vector control, this was probably far too narrow a topic to form the basis of multi-bilateral projects and programmes, and was likely to be considered as only a component of broader health-oriented activities. An alternative might be the broadening of the present mandate of PEEM, and it was stated by a Panel member that the PEEM ''package'' was too small when dealing with development agencies. It was suggested, though, that where projects incorporating general aspects of health in development had identifiable elements of environmental management for vector control, there should be specific funding for these elements in order to utilize the techniques developed or promoted through the efforts of PEEM, and to demonstrate and refine their application in practice.

The scale of the problems of environment and health in irrigation, specifically, and the limited efforts and funding for their solution were described as alarming by the representative of the International Irrigation Management Institute (IIMI). National policies and budgetary pressures, and the trend to devolution of scheme management responsibilities down to farming community level threatened to make the situation evenmore intractable. This management change was particularly evident in South-East Asia, and was spreading world-wide. It called for research and monitoring to assess the environmental implications and health consequences.

General agreement on the effects of national policies of this type led to a number of proposals for greater and closer involvement of non-governmental organizations in the work of the multinationals to enable them to expand their capabilities. This called for the identification of suitable non-governmental organizations, and also for appropriate training of their personnel.

There were various proposals for increased efforts in training, with collaboration between PEEM and other groups, including a suggestion for pilot projects and studies in selected countries. From the results of these, and subsequent project and programme evaluation, it should eventually be possible to arrive at policy evaluation and the prepa-

[1] The Commission met three times during the period of 1990-1991 under the chairmanship of Mme. Simone Veil, and its report will be published early 1992.

ration of informed policy options related to environment and health in development. This was the kind of progressive action that the multilateral agencies could encourage and promote.

5. POLICIES AND PROGRAMMES OF MULTILATERAL DEVELOPMENT BANKS AND FUNDS

The distinction between multilateral agencies and multilateral development banks and funds was a somewhat arbitrary one, as many of the latter also functioned as agencies for technical assistance. The important feature was that of investment for development which, for most of their client countries, was where the action could be seen, where the schemes became a physical reality and, as a consequence, where any potential impacts on health and the environment would be felt.

At first sight, the banks and funds with their command of finance, would seem to be in a strong position to dictate or at least to direct the treatment of environmental and health aspects of the projects they supported and thus, to a considerable degree, their sustainability, a concept that is gathering importance as evidence grows on the negative effects of many developments. The theoretical power of financing agencies was, however, put into clearer perspective at the Asian Development Bank Symposium in 1986, where it was stated that "*the capability of banks to impose conditions on loans, and their concern for the policy and institutional framework surrounding development activities does provide the chance to promote environmental planning if both bank and Government see fit*". This meant that the onus remained largely with governments and their own perceptions of how environmental and health matters fitted into their proposed development processes.

In these circumstances, it was not surprising that there was little environmental or health interest in development on the part of the investment agencies. But in 1979, a study by the International Institute for Environment and Development (IIED), financed by UNEP/CIDA, investigated the environmental procedures and practices of nine multilateral development financing agencies, and published the findings as ''*Banking on the Biosphere*''. While singling out the World Bank as having shown unique practical concern over the environmental impact of its lending, and its intellectual leadership in environmental matters in the international development community, the report stressed that its procedures and practices were far from perfect, and stood out only because the other agencies had done so little. Reaction to this criticism resulted in the ''Declaration of Environmental Policies and Procedures Relating to Economic Development'', adopted in 1980 by fourteen of the world's major investment agencies. Since then, all the agencies reviewed had taken measures to show their increased consciousness of the environmental linkages with the developments they financed, but there was little evidence that this had extended to concern for human health.

In a written contribution from the Asian Development Bank, which had formulated specific recommendations for a systematic approach to the inclusion of environmental issues in the Bank's operations, it was noted that while awareness of environmental conditions and their long-term implications had been growing in developing member

countries (DMC), this had not been matched by a change in priorities. It was concluded that any attempt to change the perception of a DMC about a particular project should be gradual and would have to be supported by a careful analysis of the trade-offs involved. In comment on this, the difficult problem of evaluating the losses arising from changes to the environment and to human health had been studied by many workers in natural resources and health, including PEEM, over recent years, and would continue to demand further research.

The approaches and the levels of resources mobilized by the investment agencies for the environmental aspects of their activities varied considerably, the World Bank maintaining its lead in terms of staff, and also in relation to country-specific activities. By 1989, it intended to have developed an "environmental issues paper" for each borrowing country to guide Bank staff on the appropriate policy approaches. In addition, with assistance from UNDP and bilateral funding, in-depth analyses of selected key environmental issues were being carried out in response to requests from Governments. These in-depth studies would develop methodologies for improved environmental management, with emphasis on refining and strengthening policies and institutions. The Bank's Economic Development Institute was producing new training material on environmental management, and the Operations Department was undertaking reviews of past projects to identify patterns and trends from which to draw lessons and to formulate recommendations for future operations.

The representative of the Inter-American Development Bank(IDB) was particularly forthcoming in informing the Panel of the general approaches, attitudes and policies of investment agencies, and in describing the Bank's progress in the incorporation of environmental matters within development activities and the structural and procedural measures that had been introduced to this end. His first point, however, was to stress that as a development bank it had to ensure a return on the money it lent. It was not a donor organization, although there were some soft loan programmes within the Bank for which grant money was available.

The Project Analysis Department in IDB had two major divisions. The first covered infrastructure and engineering, the second, agriculture and social areas, which included units for health and natural resources. The Bank also had its Environmental Management Committee (CMA), made up of the managers of technical, operations, legal, economic and social and external relations departments, and having a secretary and environmental advisers.

Projects followed a sequence of stages of identification; development (or formulation); negotiation; and execution. An attempt was being made to have environmental concerns and activities brought into this sequence as early as possible, similarly to the World Bank procedures, and the IDB also had its environmental issues paper for each country, which formed an input to a country programme paper. Taking Barbados as an example, the country programming strategy for that country was based primarily on its natural resource base and the environmental problems that it faced. The objective was to identify the major environmental issues, to present them in the country programme paper, and to attempt to carry out activities that would address and reduce the environmental problems. The aim was to encourage in-country identification of the environmental factors, and for national agencies to present any associated difficulties in con-

junction with the usual economic, financial, legal and institutional background to a request for funding.

In its efforts to raise levels of awareness and understanding of environmental issues in the Bank and in the region, consultative meetings had been held, one with heads of governments, planning ministers and environment ministers, and another with non-governmental organizations, development banks, and environment agencies of the recipient countries. Internal training in environmental awareness and environmental management had been introduced. The effects of these initiatives were becoming evident in the increased pressure from within the Bank for the review of environmental projects, and the growing concern for environmental and natural resources issues in the countries themselves. At the same time, there were still cases of reluctance on the part of resources development agencies to take full cognizance of such issues which were sometimes seen as an impediment to progress and an unnecessary cost.

On the subject of cost, if there was an additional project cost for environmental protection, then there had to be a distinct benefit. It was for economists to solve this problem, and as an example of the difficulties it may pose, the common problem of recovering irrigation costs from the beneficiaries - even without any loading for environmental measures - demonstrated the reluctance to incur further expenses. Even so, the regional banks, owned by their borrowing countries, also took into account their role in improving social well-being and were sensitive to this responsibility which might modify some aspects of the internal rate of return criterion applied in the appraisal of development projects.

The inevitable increase in the complexity of development projects where environmental and health issues were included ran counter to the recent trend toward project simplification, resulting from the banks' unhappy past experience in the area of integrated rural development. One suggestion made by the World Bank for improving performance in such complex developments was that of pilot projects of a sufficient scale to test appropriate methodologies. The IDB representative stressed the need, In such complex projects, to work progressively and with trade-offs to overcome the conflicts and friction with economists, engineers, accountants and operational units faced with the involvement of larger numbers of disciplines, agencies and bureaucracies.

The point was raised by the Panel that there were distinct groups at risk in any particular project, and if environmental measures were focused on these particular groups it could be hoped that the people most at risk would benefit: with such a focus it might be possible to reduce both the cost of the intervention and any political opposition to it.

When it came to getting the message across to financing agencies to pay more attention to health issues in the developments they supported, the achievements of non-governmental organizations in Canada, Europe and the United States were cited. Through persistent lobbying at high levels in member countries of the regional development banks, great changes had been made in environmental policy. If PEEM wished to be heard and to be effective, it must be prepared to stimulate non-governmental organizations, among others, so that its message would be directed at the agencies from a variety of sources, showing a real weight of opinion rather than a lone voice. A parallel was drawn between this proposed approach and the efforts already recommended for

PEEM and its members to activate national representatives to the governing bodies of the participating organizations; the approach was supported by the representative of PAHO.

The possibility of recommending a uniform lending policy among the major banks was raised, with the aim of then setting out criteria for health and environmental requirements to be met in national projects as a prerequisite for any loan. This was considered unlikely to have much success, but it might be feasible to ask the banks and lending organizations to try to develop a more uniform approach to "eco-conditionality" in project approval, to avoid trade-offs in sustainability and environmental quality among agencies with less demanding conditions. This might not be immediately practicable as a general concept, as it was recognized that many recipients of loans lacked the means to take proper account of or to implement environmental conditions that had been laid down but, if sufficient interest could be raised on the human health effects, a starting point could be for a common donor approach to the assessment of the problems of vector-borne diseases and the inclusion of preventive measures in their projects.

In a working document of the Commission of European Communities, it was suggested that *In view of the economic situation of many developing countries, the 'eco-conditionality' of project approval creates an obligation on the part of donors to providespecial funds for environmental cooperation.* This was not acceptable to many investment agencies, and still left open the problem of long-term funding for the monitoring of environmental and health effects, and any necessary adjustments to take these into account, well beyond the normal period of project development. A possible solution could be to encourage the support of bilateral agencies to such components, as their continuing programme approach to selected countries offered a more appropriate source of funding, and the human and social aims were entirely in line with their policies.

6. CONCLUSIONS

In selecting this topic for the technical discussion of its ninth meeting, the Panel had been aware of the fact that its limited mandate of environmental management for vector control did not constitute a basis for policy and programme formulation and analysis. At the same time, the establishment of the WHO/FAO/UNEP Panel was one of the interagency initiatives arising from the broader Memorandum of Understanding governing collaboration in the prevention of water-borne and associated diseases in agricultural water development activities.

Environmental management for vector control was an important contribution to the improvement of the health status of a community in an environment affected by the development of natural resources. The study of governmental, technical assistance, and investment agency policies and programmes, for their environmental and health content, was therefore very relevant in determining future directions of the work of the Panel, and of its participating organizations.

The study reported in the background paper (PEEM/9/TD/01) also illustrated associations between health status and policies and those developments influencing the

environment, in relation to many other areas of WHO concern. Various pressure groups, many of them non-governmental organizations NGOs, and the WCED report *Our Common Future*, had created an accelerating interest and awareness of the potential damage caused by some forms of resource development. Guidelines, institutions and measures for environmental protection were currently being developed by governments and assistance organizations. But health issues were seldom included in these initiatives or in resulting project design, operational and evaluation features. In addition, *ex post* evaluations to determine the long-term effects were usually neither planned nor financially supported.

In discussing the policies and programmes topic, the Panel had remained within its mandated area. It had also been greatly encouraged by the initiative of the Director - General of WHO in establishing the Working Group on Intersectoral Action for Health, and by the support and collaboration given in carrying out the programme of agency visits and in preparing the background document. The Panel believed that this pointed the way to a broader approach to the identification and formulation of measures for the protection and improvement of community health status, within which its own particular concern was a component of growing importance where pressure for natural resources development was giving rise to the expansion of vector-borne diseases.

The following recommendations therefore showed the forms and directions which the Panel believed its own actions should take, and which opened the way for others with similar concerns to collaborate in presenting a package of health initiatives to be incorporated in environmental protection and management measures to accompany natural resources and agricultural development.

7. RECOMMENDATIONS

The creation and maintenance of awareness

(1) The Panel should target groups within governmental, bilateral and multilateral agencies and non-governmental organizations, and identify contact points in those groups so that its publications reached the right people and its information was disseminated. To this end:

- Panel members should scrutinize the mailing list, up-dating it wherever possible;

- Panel members should make personal contacts in follow-up to expressions of interest by governmental or other agencies, including those resulting from the fact-finding mission for the background paper;

- the Panel's secretariat should regularly follow up contacts already made with interested organizations and responsible individuals.

(2) The Panel should initiate the preparation of briefing packages, in non-technical language, suitable for desk officers in bilateral and multilateral agencies, development banks and appropriate non-governmental organizations.

(3) The Panel should be prepared to arrange training seminars and workshops through the participating organizations, and should assist those organizations in identifying potential sources of funding.

For this purpose, consideration may be given to:

. drawing on the UNEP/UNESCO environmental education programme (EEP);

. collaboration with any existing activities within the participating organizations.

(In this context, attention was drawn to the recommendations of the eighth meeting of PEEM, and the technical discussion on education and training for the planning, design and implementation of environmental management for vector control).

(4) Utilizing the formal channels of communication, PEEM should brief government representatives, particularly those attending the governing bodies of the participating organizations, on the importance of considering the health status of populations (including vector-borne diseases) and the environment in the agencies' regular programmes for resource development.

Interagency collaboration

(5) Collaboration should be encouraged among the WHO Working Group on Intersectoral Action for Health, the FAO Interdepartmental Working Group on the Environment and Energy, the Environmental Health Programme of UNEP, and the Intergovernmental Panel on Climate Change, with a view to consolidating approaches and activities relating to health, the environment and the development of natural resources and agriculture.

(6) Together with any interested WHO divisions or programmes, the Panel should take the opportunity to collaborate with UNDP in the preparation, currently underway, of standard guidelines for project formulation, to ensure that they incorporate environmental and health components (including vector-borne disease control).

(7) Contact should be maintained with the Working Group on an International Commission for Environmental Assessment (ICEA), with a view to ensuring a health component in environmental impact studies, where appropriate.

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(8) The Panel should contribute to the United Nations Conference on Environment and Development through participation in the preparatory activities for the Conference, to ensure that the multidisciplinary and intersectoral nature of environmental management for vector control receives appropriate consideration within the context of health and, consequently, the environment. This participation should be accomplished

particularly within an overall WHO input, and also through the other participating organizations and the ACC Inter-Secretariat Group for Water.

Knowledge gaps, data and research requirements

(9) The Panel should stimulate interest and promote activities in the following areas of data collection and research, through its Collaborating Centres and other interested agencies:

Policy conflicts. In the light of changing emphases on resource management, conservation and vector-borne disease control interests had resulted in policy conflicts. Longitudinal case studies should be initiated into such changes and conflicts in support of policy research considering, as an example, the TVA history through pre-DDT, DDT, and post-DDT control eras.

Cost effectiveness. To assist policy-makers in selecting appropriate cost-effective measures for vector control in natural resources and agricultural development, there should be investigation, assembly and dissemination of material on studies on the economics and health impacts of alternative structural and management approaches such as canal lining, piped water supplies, water control and distribution, and operation and maintenance programmes.

Data deficiencies. Recognizing data deficiencies in relation to environmental management for vector control, the Panel welcomed the recent strengthening of its secretariat with an associate professional officer, and instructed the secretariat to accelerate the establishment of a data base on environmental management networking, with the Collaborating Centres. The involvement of suitable non-governmental organizations should be an important component of this activity.

Environmental impact assessment indicators. There should be an identification and validation of sensitive indicators to be used in environmental impact assessment for measuring the risk factors determining health status, and the types of and options for the interventions that could remove or reduce such risk factors.

Policy research. The Panel recognized the existing policy gaps in the cause-and-effect relationships between policies in sectors involved in natural resources and agricultural developments and the health status of affected populations. More solid evidence would help to convince policy-makers of the need to include a health component in the sectoral goals. Also noted was the untapped information on sectoral policies, as they existed in the pre-DDT era, to prevent disease vector impacts in natural resources and agricultural development. The Panel therefore recommended that policy research be promoted to elucidate the above-mentioned relationships, with the aim of providing an inventory of past policies which had been of proven value.

Technical assistance

(10) At the request of the secretariat of the Cairo Plan, formulated by the African Ministers' Conference on the Environment, the Panel should assist in the review of

workplans and participate in programmes relating to the water resources network and intersectoral research studies, to ensure the incorporation of appropriate features, measures and activities for environmental management and vector-borne disease control.

(11) The PEEM secretariat should give consideration to the preparation of a list of agencies and consultants with field experience of environmental management for vector control to meet possible requests from organizations engaged in development activities.

8. LIST OF WORKING PAPERS

1. Mather, T.H. and Bos, R. Policies and programmes of governments, bilateral and multilateral agencies and development banks for environmental management in the context of natural resources, agriculture and health development (PEEM/9/TD/01, published by WHO as document VBC/89.7)

2. Abu-Zied, M. The role of agriculture and irrigation development in Egypt and their impact on health (PEEM/9/TD/02).

3. Sharma, V.P. Impact of sectoral policies on the vector-borne disease situation in India (PEEM/9/TD/03).

4. Tech, C.L. Institutional arrangements for health and environmental programmes in water resource development projects in the Philippines (PEEM/9/TD/04; reprint of a working paper prepared for the fourth annual PEEM meeting, Geneva, 1984)

5. Peralta, G.L. Philippine policies and programmes on environmental management (PEEM/9/TD/05).

6. Olson, J.K. Agricultural and certain key federal and state policies with an impact on vector control in the United States (PEEM/9/TD/06).

7. Ault, S.K. An overview of the United States Agency for International Development (PEEM/9/TD/07).

8. Lopez-Antunano, F.J. Environmental health impact assessment in the American Region (PEEM/9/TD/09)

9. Zeledon, R. The water development project Arenal-Tempisque in Costa Rica (PEEM/9/TD/10; in Spanish)

PART II

TECHNICAL DISCUSSION

HELD DURING THE TENTH MEETING

LIVESTOCK MANAGEMENT AND DISEASE VECTOR CONTROL[1]

1. INTRODUCTION

The Panel of Experts on Environmental Management for Vector Control (PEEM) has long recognized the importance of livestock in the epidemiology of vector-borne diseases. It was therefore decided to focus attention on this subject in a one-day technical discussion during PEEM's tenth annual meeting, appropriately held at the Food and Agriculture Organization of the United Nations in Rome.

Although African trypanosomiasis is clearly pertinent to such a discussion on livestock and human health, it was decided to exclude this topic because trypanosomiasis is being adequately addressed in several other joint FAO/WHO meetings.

The titles of the eight working papers presented during the technical discussion session are listed in section 11 below. They served as a basis for the session and much of their contents have been incorporated into this summary of the technical discussion.

2. AGRICULTURAL CONSIDERATIONS AND POLICIES

Before discussing the possible interactions between livestock and vector populations it is appropriate to outline some agricultural considerations concerning livestock management, presented at the meeting by Timon (1990).

Problems of sustainable livestock development in developing countries

FAO stresses the importance of sustainability in any development project and defines sustainable development as follows:

Sustainable development is the management and conservation of the natural resource base, and the orientation of technological and institutional change in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations. Such sustainable development (in the agriculture, forestry and fisheries sectors) conserves land, water, plant and animal genetic resources, is environmentally non-degrading, technically appropriate, economically viable and socially acceptable.

Figure 1 illustrates some of the determinants of sustainability.

[1] Prepared by M.W. Service, Liverpool School of Tropical Medicine, Department of Medical Entomology, Pembroke Place, Liverpool L3 5QA, United Kingdom.

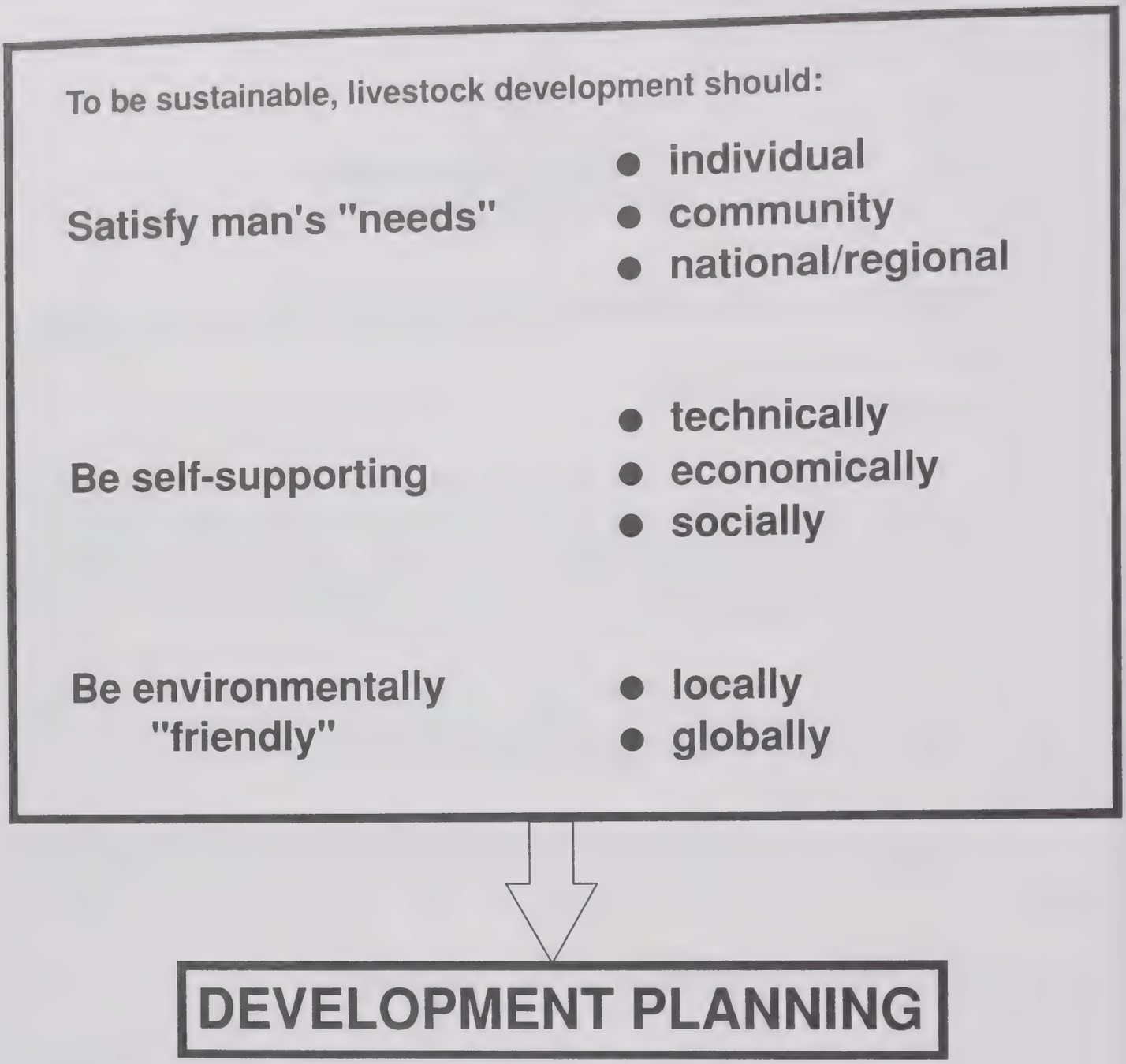

Figure 1. Sustainable livestock development: determinants of sustainability

WHO 91739

Source: Timon (1990)

Emphasis must be on balanced development for present and future generations rather than purely on preservation of natural resources. Sustainability cannot be achieved by fixed concepts - each of the components can, and will, change over time and will require concomitant changes to maintain sustainability.

In developing countries, human population growth is usually very high and in many situations exceeds increases in food production, thus exacerbating the problem of world hunger. Urbanization is accompanying population growth and is increasing dramatically, with South America having the highest proportion (72.4%) of people living in cities (Service, 1989). It is estimated that by the year 2000 over 50% of the world's population will be living in cities and by then there will be some 276 cities with more

than 1 million people. The infrastructure needed to provide adequate food and to cope with the environmental requirements of such a situation is crucial. The problems and solutions are, however, not country-specific but require considerable international cooperation; all countries must accept their responsibilities to the rest of the world. Sustainable development (by its FAO definition) must be based on long-term considerations, and sometimes it cannot be based on just a country's own resources or needs. For instance, because of the trend in many developed countries to reduce meat consumption, world meat production is expected to grow more slowly during the 1990s than it did in the 1970s. Rising demand in most developing countries, notably in Asia, will, however, continue to promote increased production, especially of pork and poultry. Increasing livestock also means increasing arable land to grow livestock feed, and to meet these demands further expansion of irrigation becomes essential. In 1985 irrigated crops constituted 35.6% of total crop production, whereas the forecast is that in the year 2000 about 43% of crops will be irrigated, and that in 93 developing countries almost 20% of arable land will be under irrigation.

Livestock production can be important in providing income to small-scale farmers and landless peasants, and in raising their nutritional status, especially that of women and children. In addition livestock can, if properly managed, have a favourable effect on the environment. For example, livestock, especially ruminants, can utilize crop residues and other wastes, as well as grazing land not suitable for crops, to produce milk and meat. Moreover, when properly managed, livestock grazing can have a stimulating effect on plant growth in grasslands.

Environmental considerations

Several important environmental considerations have to be appreciated. For instance, industrialization and deforestation may already be producing climate changes that could threaten agriculture, the ecological balance and even human health. The earth's heat balance depends on a complicated and dynamic interchange of infrared radiation between the earth's surface and the atmosphere. Much of the short-wave radiation from the sun that reaches the earth's surface is reradiated as longer-wave infrared radiation, but carbon dioxide and other gases in the atmosphere act as a filter and trap some of this energy (heat) within the earth's atmosphere. This causes a gradual rise in temperature, the so-called greenhouse effect. The other gases involved in trapping heat are the chlorofluorocarbons (CFCs), methane, nitrous oxide and ozone. Methane and nitrous oxide are produced both naturally and artificially; CFCs, however, are man-made and are used mostly in refrigeration and as aerosols and solvents.

To be sustainable, all systems of pasture use must be designed to maintain or improve vegetative cover. Poor grazing management, including overstocking, leads to deterioration of pastures and consequently to decreased animal production. Bucher & Toledo (1990) illustrate how overgrazing can influence the epidemiology of Chagas disease in South America (see section 6, below).

Overuse of fertilizers, especially nitrogenous ones, although rare in developing countries, is also potentially harmful to the environment through pollution of surface and underground waters. Alternative measures of improving soil fertility, such as use of animal manure and nitrogen-fixing legumes to supply nitrogen to both the pasture

and to the animals should be promoted. This would lessen both direct and indirect pollution (e.g., by decreasing the need to manufacture fertilizers). The use of human and animal excreta can, however, present human health hazards. For instance, apart from problems such as the spread of diarrhoeal diseases, organically polluted waters can create breeding places for certain mosquitos, such as *Culex quinquefasciatus* which is an important vector to man of bancroftian filariasis (*Wuchereria bancrofti*). Other environmental problems in developing countries may be caused by effluents from abattoirs and meat-processing facilities. Such wastes can cause environmental damage to watercourses, as well as contribute to the creation of suitable breeding places for certain disease vectors.

Some 15-25% of global methane is estimated to be produced by animals, mainly cattle, and their fermenting faeces, and is believed to contribute to the greenhouse effect. About 70% of cattle are found in developing countries.

The objective of animal health services is to optimize and maintain levels of livestock production. In developing countries, the first stage is often the control of major diseases in order to increase animal production and permit the introduction of livestock into areas formerly barred by disease constraints. Such actions can, however, result in environmental degradation and pollution through mismanagement and over-utilization of the available natural resources because of increases in both human and livestock populations. The complexity of planning for controlled settlement and area development, which ideally requires the integration of the activities of many agencies, means that degradation is not easy to avoid. Proper land use planning and utilization, taking into account the agronomic, topographic and localization aspects, are essential to minimize the risks of adverse ecological impact.

Livestock production

Livestock production systems in developing countries are numerous and varied, but traditional systems usually prevail. A few highly sophisticated livestock production models have been attempted in developing countries but with little success, mainly because very few producers have the necessary resources and knowledge to maintain such units commercially. Their survival mostly depends on direct subsidies or special support schemes for select beneficiaries. Similarly, methods used for improving livestock production and productivity in developing countries frequently focus on introducing exotic breeds, but these are often less tolerant to local climate and diseases. Mankind cannot afford to lose valuable genetic diversity, and the preservation of indigenous animal breeds is a matter of general concern, especially as long-term human needs for animals cannot be anticipated.

In his background paper on livestock production, Timon (1990) describes in some detail pastoralist systems, mixed-farming systems and specialized livestock farming systems. Although it is not appropriate to review these different systems here, a few issues he raises may, nevertheless, usefully be elaborated. For example, he points out that most farm systems in developing countries, whether subsistence smallholdings or commercially oriented mixed farms, are either not aware of, or unwilling to consider, possible problems building up for future years, such as gradual cumulative degradation of natural resources. Poor socio-economic conditions, to which rural communities are

often subjected, reinforce their struggle for survival, even at the expense of dangerous over-utilization of natural resources.

Output levels of most mixed farms are low and local experience is required to choose the appropriate mix of activities. Criteria required to make a selection involve knowledge of what activities can be successfully established, and of practical conditions concerning effective demand and access to market outlets.

Animal health

Diseases and pests inhibit livestock production and impose costs on society. According to the United States Department of Agriculture, losses due to insects, ticks and mites and costs of their control amount to 6% of farm-level cash receipts for livestock and poultry in the United States of America. The control of major animal diseases is a prerequisite to the improvement of animal production, particularly in developing countries where a number of infectious and parasitic diseases affect all livestock species and constitute a major constraint to livestock development. Improved disease control depends on the availability of appropriate techniques for diagnosis, treatment, vaccination, vector control, improvement of resistance to disease, as well as information on animal disease epidemiology and proper application of appropriate sanitary measures. Hygiene is crucial, particularly in developing countries, where people and livestock may live in close contact and where the risks of zoonoses may be continuous, such as in Asian areas endemic for Japanese encephalitis where pigs are often kept near, or even under, houses. Whereas considerable attention has been given to the impact of vector-borne diseases on livestock, and of vector-borne diseases on humans in irrigation schemes, little attention has been paid to the role of livestock in vector-borne infections transmitted to humans. Discussion of the latter interaction will be the main concern of this part of the report.

Policy issues

It must be emphasized that no particular aspect of agricultural development can be considered in isolation from others. This necessitates coordination in the planning of future development programmes to ensure that all aspects are adequately considered. Much greater cooperation and coordination is consequently required than has hitherto been the case, particularly across divisional and departmental boundaries (see figure 2 on the next page). Breeding systems need to be tailored to the particular environmental characteristics of the area. Highly intensive livestock production has special problems which may make development less sustainable. These include possible direct pollution of local soil, water and air, large-scale production and shipments of feed and concentrated processing of animal products. Intensive production may also create different and major disease risks, especially with regard to parasitic infection. The breeding system itself, which is a component of intensive systems, is unlikely to be a major cause of unsustainability in development.

The human factor is among the most important in any programme of extensive livestock development, and dialogue with and understanding of the people involved is a

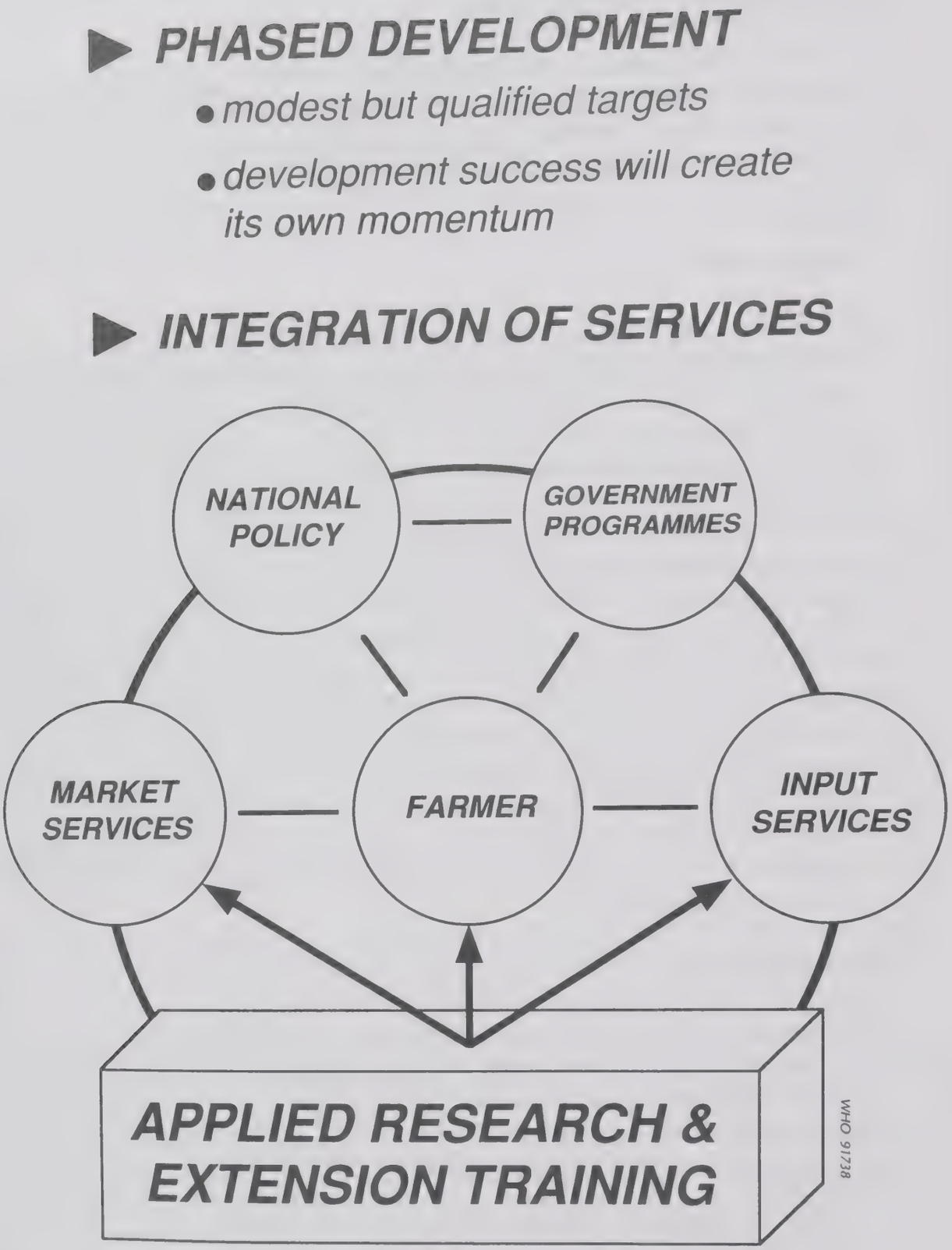

Figure 2. Sustainable livestock development = effective development strategies

Source: Timon (1990)

prerequisite to planning. There should be a vertical, not horizontal, transfer of technology to developing countries. For any development plan to succeed it must be economically attractive to the users. This may pose problems because in some countries the number of livestock is more important in terms of wealth and social status than the

quality of livestock; whereas increased productivity should concentrate on getting better quality animals so there is increased output from fewer animals. It is essential that any integrated plan finds a way to control stock numbers so that they are in equilibrium with the carrying capacity of the pasture; feed from other sources does not reduce overgrazing. If the aims of livestock development are partially or wholly for the general good of the community, or for other groups outside the development, then some form of subsidy may be needed for the farmers.

The preservation of indigenous animal genetic resources has already been referred to, but is reiterated here because it is a major policy issue of sustainable development. It is important that livestock promotion projects are developed for indigenous breeds, either in the existing environment used for production or in the environment which is likely to be the commercial environment 5 to 10 years ahead.

There is increasing awareness of the importance of the conservation of the environment and the need to minimize pollution in the execution of development projects. While greater emphasis is required on the environmental effects of sustainable development, the major issue remains the provision of adequate food for the population and satisfying other human needs. Pollution, particularly of watercourses, can be controlled by legislation, and it may even be necessary to control the density of livestock.

A primary concern of FAO is to ascertain that there is adequate planning of development projects, that initial plans are properly evaluated by all sectors concerned (even if not directly involved), and that all potential outcomes, including problem areas, are identified.

Finally, there must be critical evaluation of projects through the collection of more precise data relating to both planning and monitoring, so that realistic assessments can be made. Not only is sustainability a long-term issue unlikely to be apparent within the normal project time, but sustainability is dynamic as circumstances change. Monitoring should, therefore, be a long-term commitment by all cooperating agencies.

3. VECTOR AND LIVESTOCK INTERACTIONS

Most haematophagous arthropods which are pests of man or vectors of human disease will to a lesser or greater extent feed on animals, many of which may be domestic livestock. For example, several species within the African *Simulium damnosum* complex, which contains important onchocerciasis vectors, readily attack birds and cattle as well as man. *Anopheles culicifacies,* the most important malaria vector in the Indian subcontinent, and the Asian malaria vectors *Anopheles sinensis* and *Anopheles annularis* often prefer to feed on cattle than on man. It has been suggested that the zoophagic habits of *A. sinensis* may be partially responsible for minimizing its role as a malaria vector in some areas. Even *Anopheles gambiae*, a very anthropophagic African malaria vector, will readily divert to cattle, especially when they are numerous and outnumber people in a settlement. Other mosquitos such as *Culiseta melanura* and *Culex tarsalis*, both vectors of zoonotic arboviruses to man, commonly feed on birds. In fact, the catholic feeding habits of *Culex tarsalis* on a wide range of mammals and birds may be a contributory factor for the low endemicity of western equine encephalomyelitis and St Louis encephalitis in the United States.

Clearly, integration of livestock in agricultural development schemes to increase protein production is highly desirable, but their introduction can have adverse as well as beneficial effects on the ecology of vectors and epidemiology of the diseases they transmit. Carnevale & Mouchet (1990) give an extensive list of African parasites and diseases that can infect both humans and their livestock, including infections not considered here, such as West Nile virus, Wesselsbron virus, *Rickettsia conori*, *Rickettsia burneti*, babesiosis, and many animal schistosomes, because they are of limited importance in the present context. The World Health Organization (1979) provides a useful review of zoonotic diseases, but only some are pertinent to the interactions of livestock and vectors.

Predicting the possible changes that might arise from the integration of livestock is complicated, partly because of ecological complexities which may make it difficult to extrapolate the events arising from one situation to another. Taking a rather simplified approach, the presence of livestock (alternative hosts) can lead to:

- Reduction of biting on people and a reduced risk of transmission for non-zoonotic parasites - which has led to the idea of zooprophylaxis;

- increased population size of the arthropod pest or vector because of the provision of extra-blood resources or breeding places, leading to increased biting on people;

- increased risk of disease transmission because the alternative hosts are reservoirs of infection or are the maintenance hosts of parasites that the vectors are transmitting to man.

First, however, let us consider the reverse situation, that is, what happens when there is a reduction in livestock, and then discuss the above three outcomes that can result from the introduction of livestock, mainly cattle. Most examples will be based on mosquitos, mainly because they are the most important group of vectors and as such there is more information on them.

4. REDUCTION IN LIVESTOCK

A reduction in draught animals and other livestock has sometimes been accompanied by increased mosquito biting on man. Probably the most convincing example of ecological change leading to the detriment of human health is the classic example from Guyana described by Giglioli (1963). Before the 1960s malaria was transmitted in coastal areas of Guyana almost exclusively by *Anopheles darlingi*, a highly anthropophagic and endophilic freshwater breeding mosquito. Another *Anopheles*, namely *Anopheles aquasalis*, was also common, but because it fed on livestock it was not a pest or vector. A malaria eradication campaign based on residual house spraying with DDT virtually eliminated *A. darlingi*, and as a consequence malaria was eradicated from coastal areas, including the Demerara river estuary. During the malaria-free period the ecology and socioeconomic status of the area changed. For instance, the human population increased and most available pastures and fallow lands were converted to rice cultivation. More importantly, cattle which had formerly occupied much of the now ir-

rigated land were displaced or eliminated. At the same time mechanization replaced horses, donkeys and mules on the roads, while tractors replaced oxen for ploughing. Because of the deficit of livestock the originally zoophagic *A. aquasalis*, which, being exophilic, had not been affected by house spraying, switched to feeding on man. As a consequence, it was responsible for malaria outbreaks on the Demerara river estuary 16 years after malaria had been eradicated. In retrospect, it appears that the former abundance of livestock had been diverting the potential malaria vector, *A. aquasalis*, from man to cattle. According to F.J. Lopez-Antunano (personal communication, 1990), however, this explanation of Giglioli may not be the only reason for the reintroduction of malaria. Other factors such as the return of malaria-infected itinerant workers from the gold fields and diamond mines in the interior may have contributed considerably to malaria outbreaks in the 1960s.

A poor rice crop in many villages in an area of Indonesia in 1977 forced farmers to sell their water buffaloes, which reduced the ratio of cattle to man from 1:25 to 1:50. The main malaria vector in the area was the very zoophagic *Anopheles aconitus*, and reported malaria cases increased 5.1-fold from 1976 through to 1978. Muir (1981) believes this increase in malaria suggested that buffaloes had previously afforded the community some degree of malaria protection. In Malaysia and neighbouring countries the importance of *Anopheles maculatus* as a malaria vector has been said to be inversely correlated with the abundance of cattle in the area. Loong *et al.* (in press) also believe that the depletion of wild animals from many areas of Malaysia through hunting and the development of the land for marginal farming, in which wild animals are driven away, have favoured the spread of malaria because *A. maculatus* has been forced to switch to feeding on people.

The great malaria outbreaks in the USSR during the period 1920 to 1930 may in part have been caused by the scarcity of farm animals resulting from the economic disruption, which forced the local anophelines to feed on people. Kay (1990) points out that during the 1940s after the war in Europe, Czechoslovakia experienced increased malaria outbreaks resulting from blocked drains, the slaughter of livestock, and the return of malaria-infected soldiers. A similar situation of wartime reduction in livestock and influx of infected soldiers may well have contributed to increased malaria in certain areas of the Netherlands.

Periods of drought can also result in decreased numbers of cattle through mortality, slaughter or migration, but when rain subsequently occurs it may produce explosive increases in anopheline mosquitos, which in the almost total absence of cattle focus their attention on people. Such a situation occurred in 1967 and 1971 in South Africa and resulted in malaria outbreaks (Hansford, 1972).

Although the introduction of mechanization into rice cultivation is well documented (e.g. Wicks, 1983), there is very little information on the effect it has on vector populations and on the epidemiology of the diseases they transmit (Service, 1987). In many communities mechanization is, however, known to reduce certain types of livestock, such as oxen and water buffaloes. For example, in Pakistan each tractor has displaced on average 2.0-2.5 bullocks, but not milk cattle. Similarly, in Bangladesh, Jabbar *et al.* (1983), report that although 98% of the land is still cultivated by bullock-drawn ploughs, the relatively few tillers that have been introduced have replaced 2.0-2.5

bullocks per tiller. There is no information on what these changes in agricultural practices have had on mosquito populations, but in these areas *A. culicifacies*, a species that prefers to bite cattle, is the main malaria vector. It is therefore not unreasonable to suggest that, other things being equal, mechanization may have increased the numbers biting people, and possibly even increased malaria transmission. Rarely are other things equal, however, because such agricultural changes are often accompanied by demographic and socioeconomic changes, which may in other ways alter mosquito-people contact.

5. REDUCED BITING ON PEOPLE AND ZOOPROPHYLAXIS

The concept of zooprophylaxis is not new. As early as 1903, Bonservizi (see Kay, 1990) suggested that, in northern Italy, domestic animals indirectly protected humans from mosquito bites. In fact, zooprophylaxis has long been practised in various parts of the world to protect people from malaria, but its value has remained questionable. For example, Escalar (1933) asserts that, in Italy, within a year from the time that a ring of 20 pigsties had been built around a village malaria had been reduced to such an extent that the Government was able to relocate the nurse who had previously been dispensing quinine to the villagers. In the Philippines, when cattle were placed adjacent to a house the numbers of *Anopheles minimus* collected from the house increased, not decreased, leading Russell (1934) to argue that zooprophylaxis, at least in this instance, had failed. It has to be said, however, that neither of these two experiments is convincing and as such they add little to the controversy.

The World Health Organization (1982a) has defined zooprophylaxis as involving *the use of wild or domestic animals, which are not the reservoir hosts of a given disease, to divert the blood-seeking mosquito vectors from the human hosts of that disease.* An account with several examples of animals apparently causing a reduction in anopheline bites on people is presented by Brumpt (1944-1945) in his review of the subject. Cattle are probably the most appropriate host for zooprophylaxis because not only do several important vectors readily feed on them, but they are often dead-end hosts, that is, vector-borne parasites infecting man do not survive in cattle. But there are exceptions, such as some arboviruses and *Schistosoma japonicum.*

Bruce-Chwatt (1982) believes that increased numbers of farm animals and a progressive deviation of local *Anopheles* to cattle might have been partly responsible for the gradual decline of malaria in northern Europe, and much of the United States. Following the work of Raevskii (1942), Platonov & Tarabukhin (1942), Zavoïskaya (1942) and others (see *Med. Parasitol.* (1942) volume 11) in the USSR, the Decree of the Commissariats for Public Health and for Agriculture was promulgated in September 1940. Health administrators advised on the placement of cattle sheds and houses in relation to mosquito breeding sites. They advocated that where possible livestock quarters should be arranged in a continuous row along the periphery of settlements, and that houses should be 250-300 metres away from them.

In Trinidad, Shannon (1944) found that cattle-baited traps gave considerable protection against biting by *A. aquasalis*. In one village, having a ratio of oxen and horses to man of 1:19, the spleen rate was 12.4%, whereas in a neighbouring village

with a ratio of animal to man of 1:140, the spleen rate was 31.3%. In the same area, Senior-White (1952) concluded that cattle and horses accounted for 88.4% of all feeds by *A. aquasalis* and that there was a lower malaria incidence in villages where there was a tradition of livestock management than in villages that kept few cattle or horses. Galbaldon (1949) considered that in rural areas of Latin America horses and cattle could, under certain circumstances, give zooprophylactic protection against biting by *A. bellator*, *A. cruzii*, *A. darlingi* and *A. pseudopunctipennis*.. Horses, however, may become infected with certain arboviruses that infect man (e.g. the equine encephalitis viruses). Consequently, if they are used as a barrier to biting, then they should whenever possible be immunized against certain endemic diseases.

In Papua New Guinea, Charlwood *et al.* (1985) found that the proportion of *A. punctulatus* group feeding on humans varied considerably from village to village according to the number of animals, particularly pigs, available as alternate hosts. In one village, Maraga, there was a large animal population, mainly pigs, which slept under people's houses, and the human blood index was only 9%. In this village a unique host, a buffalo, was introduced and it was found that a diversion of 40-45% of mosquitos feeding on people occurred up to 10 metres, decreasing up to 60 metres when there was no diversion caused by the buffalo. Kay (1990) wondered what the effect would have been at Budip village where, because the village had few animals, the human blood index was 83%. On the basis of their results Charlwood *et al.* (1985) considered that a judicious zooprophylactic use of domestic animals in selected villages may reduce mosquito-people contact.

It has been suggested that in Indonesia locating cattle or other domestic animals between ricefields breeding *A. aconitus* and villages might help reduce malaria transmission (WHO, 1982a). Kirnowordoyo & Supalin (1986), however, found that in Indonesian villages the actual ratio of cattle to man (13:1-50:1) did not seem to affect the indoor or outdoor man-biting rates of *A. aconitus,* although the biting rates on humans were less in villages in which cattle sheds were away from houses and without walls and a roof than when they were of the closed type with a roof and walls and formed a part of the house. They concluded that keeping cattle away from human dwellings and near resting or breeding sites could afford some protection against malaria.

In very small-scale trials in the Philippines, Schultz (1989) found that the presence of water buffaloes decreased by about 50% the number of mosquitos biting people in bait catches, including a 42.3% reduction of *A. flavirostris* and a 37.7% reduction in *A. annularis*. In contrast, the presence of cattle near houses was clearly disadvantageous as it caused an increase of about 72% of mosquitos biting people inside houses, including increases of 44.6% and 180% of *A. flavirostris* and *A. annularis* , respectively.

In Kowanyama in northern Queensland, Australia, it had been suggested that removal of dogs from the village would be an appropriate solution to human dirofilariasis (30% of the aborigines had antibodies) which caused coin lesions in the human lung. Feeding studies by Kay *et al.* (1979) and Kay (1985), however, demonstrated that the 100 dogs in the village were receiving over 41% of mosquito bites, while mosquito attacks on the aboriginal population of 850 was limited to 3-11%. It was thus consid-

ered that the village dogs, which often encircled aboriginal outdoor social groups during times of high mosquito activity, were acting zooprophylactically and therefore should not be removed. Care should, nevertheless, be exercised in such situations, that is where the ''barrier animals'' (dogs in this instance) are reservoirs of infection, because reduced biting rates on people might be accompanied by a higher infection rate. For example, the presence of dogs will in many areas of the world (Europe, the Middle East, China, Central Asia and Latin America) increase the likelihood of transmission by phlebotomine sandflies of visceral leishmaniasis (kala azar) caused by *Leishmania donovani*, because they are reservoir hosts. In fact, killing dogs is a form of control practised in some countries, e.g. France, Italy and China. Currently, there is interest in introducing non-zoonotic hosts, such as cattle, into leishmaniasis endemic areas to reduce transmission, but field experiments are needed to determine whether local phlebotomine vectors will feed on introduced hosts such as cattle.

It has been suggested that in parts of West Africa the presence of cattle may divert species of the *Simulium damnosum* complex, vectors of onchocerciasis (*Onchocerca volvulus*), away from biting people. There is, however, no reliable information on this. Another possibility is that infection of people with non-pathogenic animal *Onchocerca* spp. (e.g. *O. ochengi*, *O. gutturosa*, *O. dukei*, *O. armillata*) may stimulate an immune response and create cross-immunity to *O. volvulus*. Similarly, it is possible that mosquito-transmitted animal filaria may impart some cross-immunity against infections with *W. bancrofti* and *Brugia malayi*. It should be mentioned here that Nelson *et al.* (1962) defined such cross-immunity i.e. *the prevention or amelioration of disease in man as a result of previous exposure to heterologous infection of animal origin* as zooprophylaxis. The use of the word as in the context of this paper - that is animals protecting humans from vector-borne diseases, especially malaria - predates the different usage by Nelson (1979) and Nelson *et al.* (1962).

In South Africa in 1960, Du Toit kept five bluetongue susceptible sheep within 50 metres of eight cattle; after three months all the cattle had contracted bluetongue virus, but at the conclusion of the five-month test period the sheep were still uninfected. Du Toit concluded that cattle were far more attractive hosts to *Culicoides imicola* than sheep, and as such had afforded them protection. This led Nevill (1978) to suggest that if a few cattle were kept with or near flocks of sheep in South Africa then most bites from *Culicoides* spp. (e.g. *C. imicola*) would be on the cattle, and this would reduce the risk of transmission of bluetongue virus to sheep. He also believed that this 'decoy' approach together with immunization should afford protection not only against bluetongue, but also possibly against Rift Valley fever, Wesselbron and African Horse sickness. As Kay (1990) pointed out, seven years of keeping cattle together with sheep seems to have convinced farmers that zooprophylaxis - at least in this instance - works.

Walton (1958, 1962) believed that in East Africa, keeping chickens and other domestic fowl in and around the village houses could reduce transmission of tick-borne relapsing fever (*Borrelia duttoni*), because the vector ticks - species of the *Ornithodorus moubata* complex - would to some extent be diverted to feeding on the birds.

The efficacy of zooprophylaxis might be increased if cattle were regularly sprayed with insecticides such as permethrin or deltamethrin. Schemanchuk & Taylor (1984) discussed the protection offered by several pyrethroid insecticides against simuliid blackflies. Kuntz *et al.* (1982) suggested that insecticide-treated cattle could be used

against *Psorophora columbiae* mosquitos in ricefields in the southern United States. In eastern China, cattle have been sprayed with permethrin in rice irrigation areas where there were high densities of *A. sinensis* (Self 1987). In the United States, however, bioassay tests indicate that mortality decreases rapidly after a week (McLaughlin *et al.*, 1989). Other problems are that many pyrethroids are repellent and may direct mosquitos from sprayed cattle to feeding on people It may also prove too costly or impractical to spray livestock at regular intervals. When cattle were sprayed with deltamethrin in Zimbabwe, however, there was no repellency of *Glossina pallidipes* and *G. morsitans* (Thomson, 1987).

Subcutaneous injections of cattle with ivermectin have been reported to control the one-host cattle tick *Boophilus microplus* (Nolan *et al.*, 1981), several three-host ticks (Drummond *et al.*, 1981), and also *Haematobia irritans* larvae in dung for up to 28 days (Miller *et al.*, 1981), and more interestingly to have caused high mortality in biting adults of *Culicoides brevitarsis* for 10 days, and occasionally for 24 days (Standfast *et al.*, 1984). It also seems possible that ivermectin-contaminated dung may kill *Culicoides* larvae.

Strong & Wall (1990) gave a brief review of the role of drugs and pesticides applied to livestock for control of parasites, including their action on non-target organisms.

Another tactic is to spray animal shelters with long-lasting residual insecticides, but although this can reduce mosquito numbers feeding on animals, it may divert them to attacking the human population. In some countries, such as Thailand, farmers protect their animals - cattle and/or pigs - at night with mosquito nets. While this may reduce the transmission of Japanese encephalitis, it may also divert mosquitos to biting people.

If a vector population has reached the carrying capacity of the area, or if the species is predominantly zoophagic, then it is likely that introducing a high density of livestock will result in reduced biting on people and a decrease in disease endemicity. On the other hand, Sota & Mogi (1989) showed, by constructing a model for a mosquito vector feeding on man and domestic animals and by combining this with a malaria transmission model, that the introduction of animals can increase vector population size. Moreover, in some situations this can result in increased biting density on man, and also increased malaria transmission. Similarly, Saul (1990) has shown that theoretically there may be increased malaria transmission when alternative hosts are introduced (see figure 5 below). See section 8 for accounts of computer simulation models as an aid to predicting outcomes of integration of livestock on vector biting rates on people.

Another consideration that should be taken into account is that rearing large numbers of livestock may increase larval breeding sites. For example, cattle hoofprints or borrow pits dug as cattle watering holes may provide additional mosquito larval habitats. Rajagopalan *et al.* (1990), reported that in India unregulated keeping of domestic animals in urban areas aggravated breeding problems by providing faeces-polluted standing water which is attractive to ovipositing *Culex quinquefasciatus* , an important vector of bancroftian filariasis (*Wucheraria bancrofti*). In addition wandering pigs and cows may destroy banks of unlined drains and create more shallow larval habitats.

Although there are, as seen above, a few examples where animals have reduced, or appeared to have reduced, vectors biting on people it must be stressed that there are virtually no good examples where their presence has been shown to reduce disease transmission, mainly because relevant epidemiological studies have not yet been undertaken.

It is important to realize that farmers will not adopt zooprophylaxis unless they perceive the rearing of livestock as compatible with local agricultural practices, and it gives them a good economic return, unless of course they receive some other form of incentives.

6. INCREASED VECTOR POPULATIONS AND BITING

In the Americas cattle and other domestic livestock are commonly fed upon by *P. columbiae*, a pest mosquito breeding in ricefields, and which in Texas is a potential vector of western and Venezuelan equine encephalomyelitis viruses. Kuntz *et al.* (1982) showed that cattle, and to some extent horses, served as the primary sources for blood-meals. Cattle also create additional larval habitats through their hoofprints (Meek & Olson, 1977). Results of these studies, coupled with those of Meek & Olson (1976) indicate that cattle are a very important component in the ecology of *P. columbiae* in Texas ricefields. A direct relationship between mosquito densities and host abundance in California was shown by Al-Azawi & Chew (1959). They found that in irrigated areas without cattle adult densities of *P. columbiae* were 0.8/m^2, whereas when there were cattle (unspecified number) densities increased 13-fold, to 9.8/m^2. Furthermore, Meek & Olson (1977) found that eggs were about five times more numerous in fields with, than without, cattle; similar associations were found by Chambers *et al.* (1981) and Williams *et al.* (1983). Even more convincingly McLaughlin & Vidrine (1987) used regression techniques to quantify the relationship between larval densities and the density of cattle within a one-mile radius. They estimated that there was about a two-fold increase in larval density, with an increase of 10 cattle per square mile.

Hansen *et al.* (1990) also stressed that livestock may create breeding places for mosquitos. For example, in Asia, bathing pools for buffaloes are used as larval habitats, especially in the dry season, although this source of mosquitos will be reduced when farming mechanization results in decreased numbers of buffaloes.

Focks & McLaughlin (1988) in reviewing their previous simulation models on ricefield mosquitos conclude that host abundance, in this instance cattle, is the main determinant in the abundance of *P. columbiae* in rice irrigation schemes in Texas. Now, although these examples are from the United States and mostly concern a notorious pest mosquito, the findings are likely to be relevant to tropical agro-ecosystems where livestock such as cattle are introduced. It might also be mentioned that biting by adults of *P. columbiae* and other mosquitos as well as ceratopogonid midges (Standfast & Dyce, 1968) can have adverse effects on cattle, such as being responsible for reducing weight gain and reduction in milk production (Steelman, 1976; Steelman & Schilling, 1977; Steelman et al., 1973). Drummond *et al.* (1988) reviewed the extensive economic losses to livestock that can be caused by biting flies. In tropical environments mosquitos may also be detrimental to animal husbandry, but very little is known

about this or, apart from tsetse flies, the importance of a multitude of other haematophagous insects which attack cattle and other livestock.

Mogi (1987) has described how in Japan the numbers of farmers keeping cattle, pigs, horses, sheep and goats slowly increased from 1945 to the mid-1950s when the numbers decreased, although the actual numbers of animals steadily increased through the 1980s because farmers kept more animals. This increase in numbers of animals necessitated larger animal sheds which tended to be built further away from houses and ricefields. Rather surprisingly, vector abundance did not apparently alter during these agricultural developments, illustrating the difficulties of predicting the consequences of agricultural changes.

In Central and South America triatomine vectors of the zoonotic Chagas disease (*Trypanosoma cruzi*) feed not only on people but on a wide range of domestic and peridomestic animals such as dogs, cats, armadillos, opossums and rodents, some of which are important reservoir hosts. They have also been reported feeding on pigs, goats, cattle and horses, but the proportion feeding on livestock is generally low (<1 - 10%), and these hosts are seldom, if ever, infected with trypanosomes (Minter, 1975). However, triatomine bugs feed much more frequently on birds (proportions of about 7% to 74%) including domestic fowl, and it is not uncommon to find large numbers of bugs resting in chicken sheds. Birds are unsusceptible to infection, so they may be considered beneficial in diluting infection rates in the vectors. On the other hand, it can be argued that they build up local bug populations leading to increased feeding on humans. Relocating chicken sheds away from houses might reduce the size of the household bug population.

Bucher & Toledo (1990) have described how in Argentina there is often a cycle of habitat destruction, poverty and increased risk of Chagas disease. For example, overgrazing by cattle leads to a deterioration of grasslands, with the result that there is often a gradual replacement with goats which in turn increase degradation. Moreover, increasing the number of goats, which are kept in corrals placed very near houses, builds up the population of triatome bugs (e.g. *Triatoma infestans*). Soler *et al.* (1977) estimated that there were sometimes some 20 000 triatomines in a single corral, and these bugs readily invade the nearby poorly constructed houses. As a consequence, there is increased risk of disease transmission (Bucher & Schofield, 1981). It may be remembered, however, that much transmission occurs via blood transfusion, for example in Sao Paulo, Brazil, about 40% of Chagas cases arise from blood transfusion (F.Dias de Avila Pires, 1990, personal communication). Bucher & Toledo (1990) argue that the solution to Chagas transmission in rural areas is improved livestock management that is compatible with the environment. They cite two examples of livestock management practised in the Salta area of Argentina which have restored the original productivity of the ecosystem. In fact, these two projects are among the very few in South America on sustainable productivity that have reached an operational level (Solbrig, 1988). In both cases, ecosystem restoration is based on enclosing areas to allow natural vegetation to recover leading in some cases to afforestation, while cattle grazing is under a controlled and managed regime. Both are long-term management systems.

There are a number of other insects feeding mainly on livestock, but which can be troublesome to people. For example, the introduction of horses or cattle near

habitations may give rise to nuisances by stable flies (*Stomoxys calcitrans*, *S. sitiens* and *S. nigra*) which breed in straw, manure or livestock food contaminated with faeces or urine. Adults are strong fliers and are not infrequently caught 3-4 km from their breeding sites. Apart from biting people they are vectors of nematode worms, e.g. *Setaria cervi* to cattle and *Habronema* spp. to horses, and of course Surra (*Trypanosoma evansi*) to a wide range of domestic hosts. Stable flies are, however, usually more common in temperate than tropical regions. Tabanids, however, are sometimes more efficient vectors of Surra than stable flies, and many species biting cattle will attack people. Although outside the scope of this technical discussion, it should nevertheless be remembered that an increase in dung may encourage the breeding of numerous muscid flies which can play a role in the transmission of a variety of diseases including diarrhoeal diseases and trachoma. Also, in some parts of the world, animal myiasis can be an economic threat, for example in Central America livestock losses due to *Cochliomyia hominivorax* amount to US$ 85 million a year. In Brazil it is estimated that *Dermatobia hominis* in cattle costs US$ 200 million a year through loss of meat and milk production and damaged hides. Larvae of both these flies can also infect people.

7. INCREASED DISEASE TRANSMISSION

Japanese encephalitis

Japanese encephalitis occurs from India eastwards through Thailand, Malaysia, Indonesia, China, the Philippines to Japan, the principal vector being *Culex tritaeniorhynchus* which breeds in ricefields. Pigs are the major amplifying hosts and their density in a region is a major determinant of epidemic activity. In many areas in South-east Asia pigs are kept very near houses, often adjacent to them or even underneath them, thus facilitating transfer of virus from pig to man. Birds, especially aquatic ones, also provide a reservoir of infection.

In 1977, the Sri Lankan Government initiated the Accelerated Mahaweli Irrigation Scheme for growing, mainly, rice on about 127 000 ha of land. Over seven years some 150 000 families were resettled and in one area farmers were advised to keep pigs to supplement their income. Not surprisingly this resulted in outbreaks of Japanese encephalitis: 407 cases in 1985-1986, followed by an additional 150 cases in 1987-1988. Now, aware of the dangers of mixing pig-keeping with rice cultivation in Asia, a vaccination programme is government policy.

In Asia, pig farming has to be reconciled with the potential spread of Japanese encephalitis. What is particularly relevant is the relative abundance of pigs to man, and their accessibility as hosts compared to man (see figure 3). For example, in the early 1950s when morbidity from Japanese encephalitis was highest, the pig to man ratio in Japan was 10^{-2} or less (figures 3a,d), whereas now it is about 10^{-1} (Mogi, 1990). This increase in the pig to man ratio has been accompanied by a decrease in the numbers of pig farms (figure 3e), because the number of pigs per farm has increased exponentially (figure 3f). Other changes are that pig farmers are now generally living further away from piggeries, and people are more protected from mosquito bites by better housing, screened windows and bed nets. Also, because of air conditioning and television people are staying indoors more in the evenings. All these social and economic changes have a bearing on the epidemiology of Japanese encephalitis.

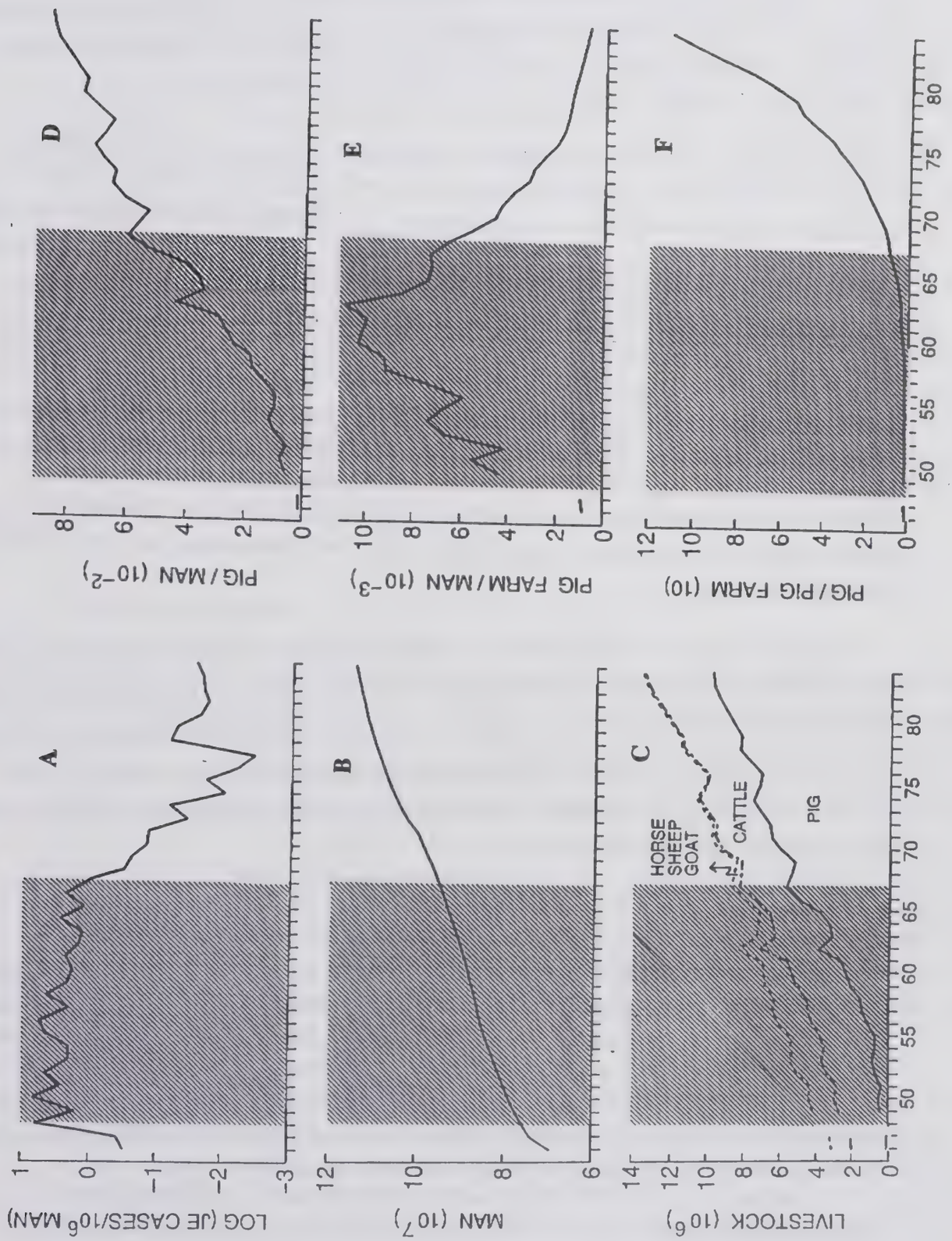

Figure 3. Development of human population densities, pig and other livestock densities and trends in Japanese encephalitis infections in Japan during the period 1946-1984. For further reference, see text on opposite page.

The number of pigsties in Japan slowly increased up to about the mid-1960s then levelled out, whereas the number of pigs continued to increase (figure 3c). Contrary to expectation this was not accompanied by an increase in cases of Japanese encephalitis, but a reduction in its incidence (figure 3a). This decline in Japanese encephalitis is likely to have resulted from a combination of factors, such as reduced numbers of vectors breeding in ricefields because they had been sprayed with insecticide against rice pests, vaccination of the human population, and moving pigs away from houses to reduce man-vector contact (Self, 1987). Nevertheless, there has been a recent resurgence of pig epizootics of Japanese encephalitis (Mogi, 1987).

Culex tritaeniorhynchus is zoophagic and apart from feeding on humans and pigs will readily attack cattle. As pointed out by Carey *et al.* (1968) cows can on the one hand lead to an increase in the vector population by supplying a blood source for reproduction, but at the same time decrease the transmission efficiency of Japanese encephalitis in the mosquito-pig cycle. Wada (1988) pointed out that it can be difficult to decide whether cows in rice-producing areas are beneficial or not. Mogi (1990) believes that livestock management by itself cannot provide a reliable and sustainable method for control of Japanese encephalitis, because small changes in environmental conditions, such as wind direction, can allow biting populations to switch to feeding on people. He believes that some form of control is needed that kills vectors attracted to the barrier hosts, such as insecticide spraying of pigsties, cattle sheds or the use of insecticide-impregnated nets over livestock. Such measures are likely to be accepted by farmers who will perceive them as reducing biting on their animals, and thus promoting better productivity.

It should be pointed out that efficient vaccines exist and in theory Japanese encephalitis is entirely preventable; but economics prevent this approach in many areas(Umenai *et al.*, 1985). Another problem is logistics. For example, the large turnover rates of pigs will hinder vaccination programmes. In the near future, however, genetic engineering techniques should make it possible to produce cheaper vaccines and, if the logistics of delivery are overcome, Japanese encephalitis should disappear from much of its current area of distribution.

Other encephalitides

Numerous house sparrows nesting around houses, farms and their outbuildings will divert feeding of *Culex tarsalis*, the primary endemic and epidemic vector of western equine encephalomyelitis in the United States, away from man but as passerine birds are amplifying hosts their presence can increase, not decrease, virus transmission to man. Hess & Hayes (1970) believed that cows and possibly dogs would be the most effective animals to divert *C. tarsalis* away from man and amplifying bird reservoirs of western equine encephalomyelitis and St Louis encephalitis.

Rift Valley fever

Rift Valley fever is a zoonotic disease caused by a virus infecting sheep, goats, cattle water buffalo and camels, and is characterized by high mortality in lambs and calves as well as abortion in sheep and cattle. The virus has been isolated from 20 mosquito species, but transmission is mainly by *Aedes lineatopennis*, *Aedes caballus*

and *Culex theileri* and also occasionally more directly through man handling infected material. In 1950-1951 an epidemic in South Africa resulted in some 100 000 deaths of cattle and sheep, and an estimated 20 000 human cases (Theiler & Downs, 1973). Another large epizootic occurred in 1974-1976 (Gear *et al.*, 1977) involving both livestock and several human cases. In 1977-1978 there was a widespread epizootic in Egypt with extensive human involvement culminating in about 18 000 human cases and 598 deaths (Hansen *et al.*, 1990; Johnson *et al.*, 1978), although the actual numbers infected may have reached 200 000 (Meegan, 1979). *Culex pipiens* was considered the probable vector in the Egyptian outbreak. As Carnevale & Mouchet (1990) point out, the explosive outbreaks in Egypt were unusual in occurring in areas outside its previous geographic range, i.e. sub-Saharan Africa, and also by the unprecedented clinical severity. Recently Rift Valley fever has been reported in West Africa, from Gambia, Mali, Mauritania and Senegal.

In many parts of sub-Saharan Africa cattle are considered the most important amplifying hosts of Rift Valley fever (Davies, 1975) but in some areas, including Egypt, sheep may also be important in virus amplification, much depending on local economics and farm practices. Hansen *et al.* (1990) point out that there are indications that ecological changes have facilitated endemic conditions becoming epizootic in parts of Africa, and that outbreaks in Egypt and other parts of Africa have been associated with irrigation developments and wetland areas. Immunization of livestock is the key to effective control of Rift Valley fever (Assad *et al.*, 1983; WHO, 1982b).

Tick-borne diseases

Livestock, such as cattle, goats and sheep can cause substantial increases in ixodid and sometimes agasid ticks, some of which apart from feeding on animals, will attach to people. Where livestock share farmer's quarters, ticks are especially prone to transfer to man. Although endemic relapsing fever (*Borrelia duttoni*) is not a zoonotic disease, increased numbers of its vectors, mainly species of the *Ornithodorus moubata* complex, arising from feeding on fowls, goats and sheep, may favour the spread of relapsing fever among the human population. On the other hand, Walton (1958, 1962) presents an interesting account of the significance of domestic fowl in the biology of the *O. Moubata* complex, and how the presence of chickens in houses may reduce the risk of people becoming infected with relapsing fever (see also section 5 above). Transovarial transmission ensures that the spirochaetes are maintained in the tick population, even if several feeds are on livestock.

The virus causing Crimean-Congo haemorrhagic fever occurs in cattle, sheep, goats and horses and in some wild fauna; the disease is widespread in many parts of the world ranging from Europe through Africa to parts of Asia including western China. Ticks, especially of the genus *Hyalomma* , spread the disease, and the incidence of the disease is linked to the density of adult ticks and abundance of large domestic animals to which they attach. There appears to be increased risk of transmission following environmental changes, including flood or irrigation, which can facilitate the proliferation of certain species of ticks.

The interaction of ticks, man and cattle is well illustrated by the epidemiology of Kyasanur Forest disease in India. The viral causative agent causes epizootics in forest monkeys which act as amplifying hosts. Larval and nymphal ticks attach to monkeys and rodents, adults which are not found on rodents and other small animals and rarely on monkeys, climb on to large mammals such as deer and bison. The emergence of Kyasanur Forest disease as a human disease began in 1957 in Karnataka (Mysore) State, where an expanding human population resulted in more cattle, which during the wet season were grazed at the edge of, or in, forests. The cattle then became heavily infected with ticks, such as *Haemaphysalis spinigera*, and brought ticks in close association with villagers. Cattle undoubtedly play an important role in tick reproduction and in their maintaining a high population density. In fact cattle rearing can be considered the most important man-made factor favouring high vector density at the very places frequented by people. More recently, large numbers of goats have been introduced in Kyasanur Forest disease areas, and it is possible they may also become involved in the ecology of the disease.

Spraying or dipping cattle results in significant control of ticks for up to about a week, but not for longer periods.

Schistosomiasis

Schistosomiasis is often regarded as one of the hazards of irrigation. Strictly speaking, schistosomiasis is not a vector-borne disease because snails are not vectors but intermediate hosts; this subtle distinction does not, however, affect the discussion. Although, as pointed out by both Carnevale & Mouchet (1990) and Hansen *et al.* (1990), all three major schistosome infections of humans can be found in animals, the only important schistosome that is zoonotic is *Schistosoma japonicum*. This is found in China, Laos, the Philippines, Thailand, Indonesia (central Sulawesi only) and formerly in Japan, and is transmitted by amphibious snails of the genus *Oncomelania*. Unlike other forms of schistosomiasis, animal hosts, including livestock such as cattle, buffaloes, pigs and goats, are extremely important in transmission - which can be maintained in the absence of man. In an endemic community in the Philippines, dogs, cows, pigs, rats, water buffalo and goats - in decreasing order of importance - were considered responsible for about 25% of environmental contamination with schistosome eggs. In China, Mao & Shao (1982) believed that cattle are by far the most important reservoir host in the epidemiology of *S. japonicum* , especially where they are grazed in marshy areas on weeds infested with *Oncomelania* snails. Inadequate coordination between the Chinese ministries of health and agriculture is a major obstruction in effective control of the disease, particularly in the marshlands and lake regions of central China, where livestock is the single most important epidemiological determinant of transmission patterns (Mott, personal communication).

In Japan, the reduction of snail populations has not only reduced the infection rate of *S. japonicum* in humans but also in cattle, dogs and rats which are reservoir hosts (Hunter & Yokogawa, 1984). Usually, however, where domestic animals are infected and may form a reservoir of the disease, effective control of schistosomiasis has required a coordinated treatment (drug) of animals as well as humans, in addition to snail control. However, partly because of the poor sustainability of environmental control measures and lack of success with this approach, the current trend is to base control on

antihelminthic drugs, despite their relatively high costs and some undesirable side-effects.

Hansen *et al.* (1990) raised the intriguing and controversial question of whether there is any value in cross-immunity to human schistosomes when people are infected with non-pathogenic animal schistosomes, and whether it can provide some form of protection. The problems of livestock schistosomes and their potential interaction with human schistosomes were apparently stressed at the OCCGE-CERMES conference in Niamey, Niger (Carnevale & Mouchet, 1990). For example, in farms in some parts of South Africa where a high proportion of livestock were infected with *Schistosoma matheei*, over 20% of the human population may be infected with this parasite; on one farm where about 80% of the livestock were positive up to 40% of the people were infected (Euzeby, 1984). Does this convey any protection against infections with human schistosomes?

Although not vector-borne parasites, Hansen *et al.* (1990) point out that in Asia intestinal flukes (*Fasciolopsis buski*), and in the Americas, Europe and North Africa liver flukes (*Fasciola hepatica*) have snails as intermediate hosts, and that the introduction of livestock infected with these parasites may pose a threat of human infection. The risk of human involvement might be rather greater with *Fasciolepsis* than with *Fasciola,* whose public health importance has not been substantiated so far. They also reiterated the warning given by Gerberich & Laird (1985) that care needs to be exercised in introducing fish into water systems, for food and/or mosquito control, because over 80 species act, together with snails, as secondary hosts of the oriental river fluke (*Clonorchis sinensis*) which infects both man and livestock.

8. SIMULATION MODELS

Mathematical and statistical methods have played an increasing role in ecological and epidemiological studies, but much of the literature is abstract in character and tends to be remote from field situations, as well as detached from practical issues. While mathematical models can never be a substitute for needed epidemiological analysis of specific situations they can assist in explaining events or predicting the outcome of events. Because of the complexities of the ecology of vectors and the natural history of the diseases they transmit, mathematical models usually have to consist of numerous equations which contain many rate parameters.

Models are often useful in identifying whether important results are sensitive to change in certain parameters. For example, they show that in most epidemiological situations small changes in vector survival rates have a much larger impact on disease transmission than changes in vector population size. Some parameters may be easily measured or estimated from field data, other times they may involve a considerable amount of guesswork. Models can help to identify areas in which knowledge is inadequate, and provide guidance in the type of epidemiological data that need to be collected and the level of precision required.

Simulation models are more realistic than the early empirical equations, and draw attention to the importance of interaction networks. Nevertheless, they have their

drawbacks. Often they are so complex that the ''essence'' of the system is lost in a confusion of equations that the epidemiologist/biologist finds difficult to understand, let alone appraise critically. Few simulation models have dealt with the interactions of livestock, vectors and diseases . In the United States, however, Focks & McLaughlin (1988) have produced a computer model to explore the effects of vertebrate host density on mosquito abundance in order to assist in the management of *P. columbiae* in rice agro-ecosystems.

At about the same time, Sota & Mogi (1989) were the first to model the effectiveness of zooprophylaxis for malaria control. They developed a model with a vector mosquito population having two blood-meal hosts (people and a domestic animal) and concentrated on the relationship between host density, vector survival rates and vectorial capacity. Their model suggests that if introduced livestock are readily fed upon by mosquitos, then their populations might increase leading to greater biting on people and raised infection rates. They predicted that extinction of malaria would occur only when there were very large numbers of easily accessible livestock (as compared to man).

Later simulation models concerning zooprophylaxis for Japanese encephalitis control have identified two important points relevant to livestock management (Mogi & Sota, 1991; Sota & Mogi, 1990). These may be summarized as follows. First, if vector and human populations remain unchanged, the risk of people being bitten by infective mosquitos is not a simple increasing function linked to an increasing pig population, but has a maximum risk at a pig population where the total number of vectors biting man is approximately equal to the total number of vectors biting pigs (see figure 4). This means that human risk will be maximized when the vector has approximately equal opportunities of virus inoculation (not necessarily infectious) to pigs and man. It is not so much the absolute pig population but their relative abundance, attractiveness and accessibility compared to that of man which is important in determining the extent of human risks.

The second point that arose from their model is that the introduction of livestock , such as cattle, which attract vectors but play no epidemiological role, could theoretically suppress virus amplification and alleviate human risks **but only** if the mosquito population does not increase in size. If the vector population does increase, then human risks may either increase or decrease, depending on the relative abundance, attractiveness and accessibility of cattle (figure 4).

Saul (1990) presents a model on the effect of introducing cattle into a malarious area, which is based on his cyclic feeding model (Saul *et al.*, 1990) with adaptations to incorporate the rates at which vectors locate a host and the rates at which they die during host seeking. In formulating the model, the feeding cycle is divided into three phases. The first is the searching time needed to locate a host, and the model assumes this will depend on the density of suitable hosts and their attractiveness, and that vector mortality is dependent on the time taken to locate a host. The second phase is the time taken to engorge, and allows mortality to be incorporated. Finally, the third phase is the remainder of the feeding cycle and would normally, but not necessarily, include oviposition. It is assumed to be of constant time and has associated mortality.

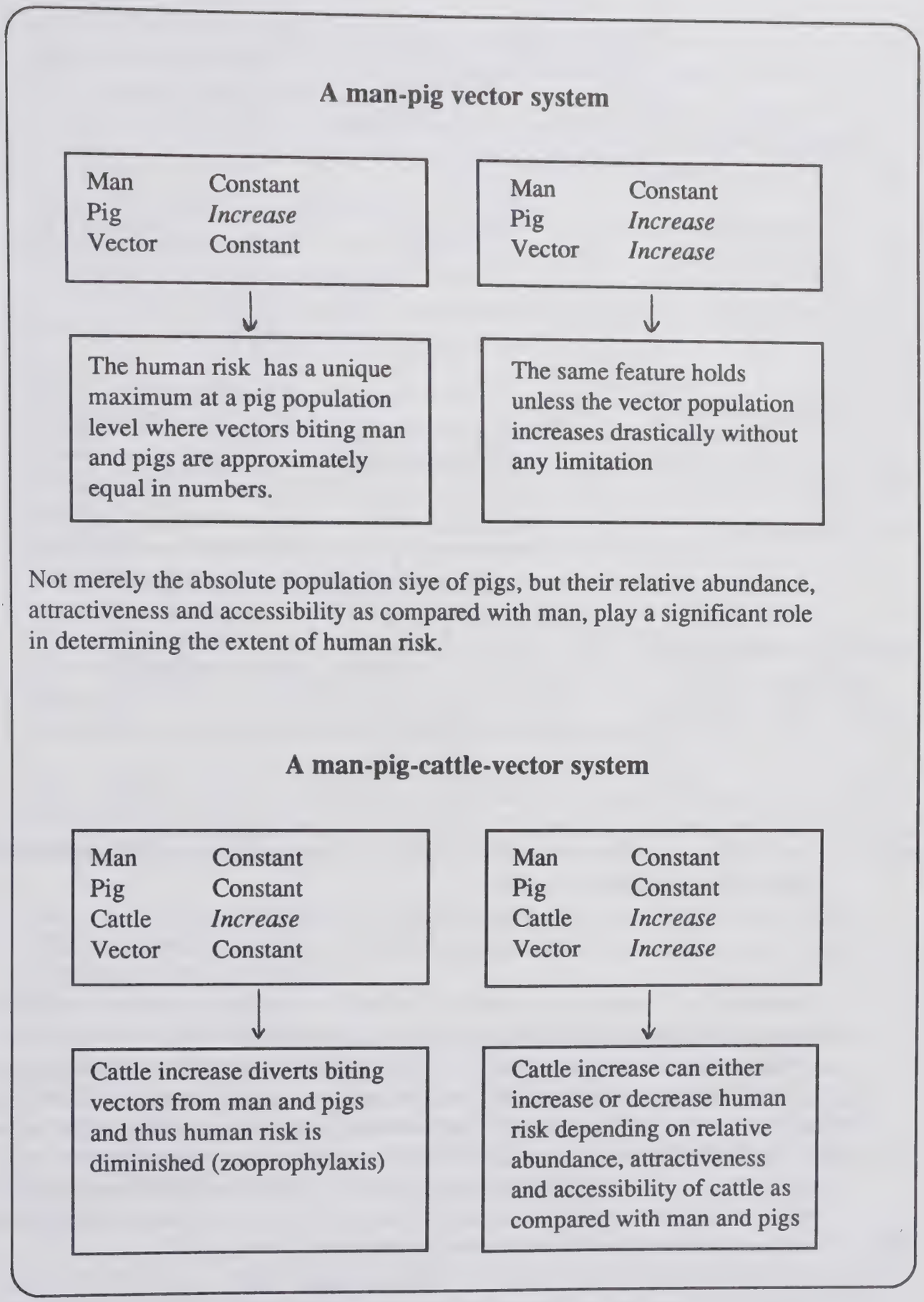

Figure 4. Different outcomes of a simulation model concerning zooprophylaxis for Japanese encephalitis

Source: Mogi, 1990

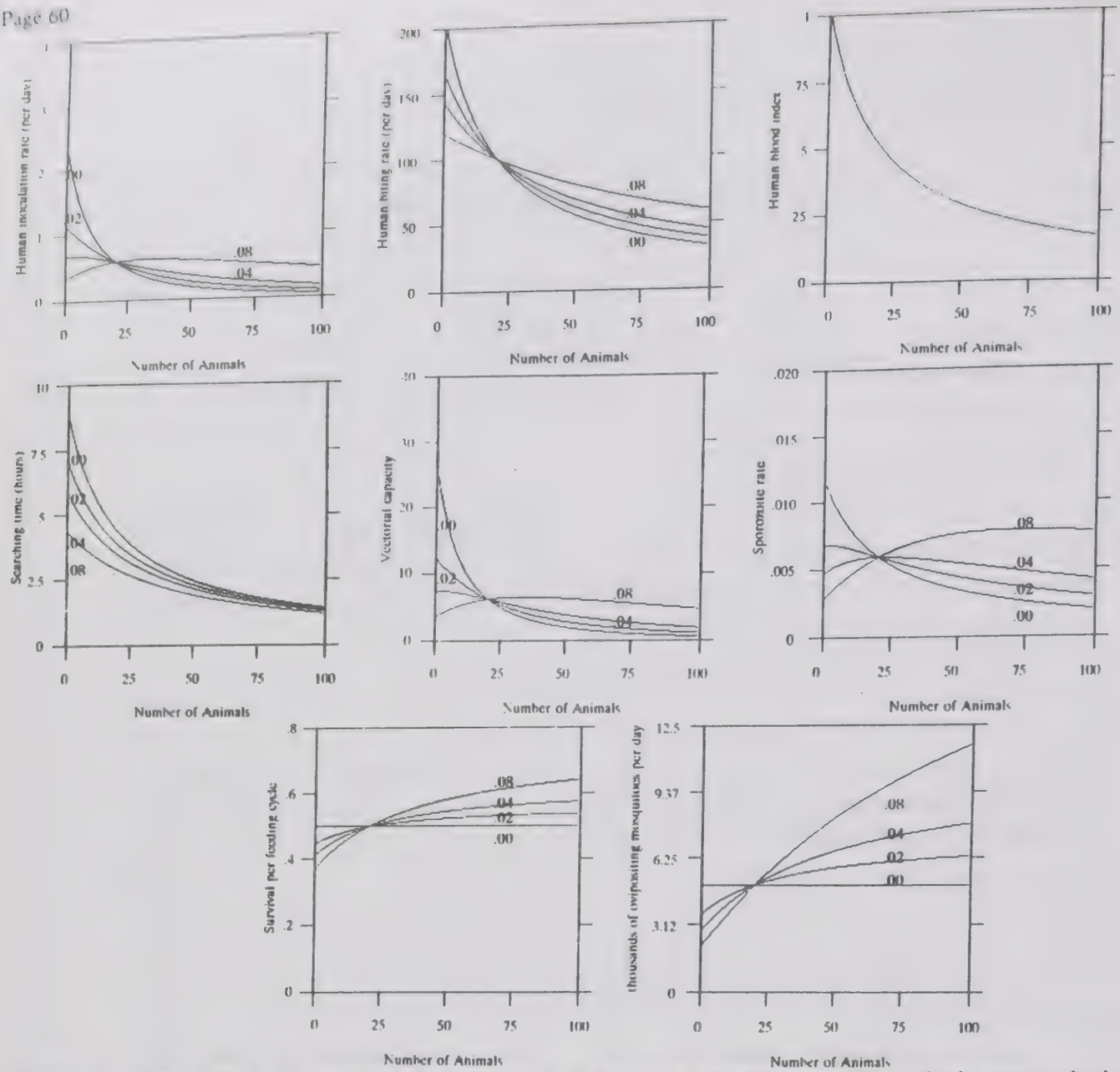

Figure 5. The effect of variation in a number of livestock parameters on malaria transmission indicators in a simulation model

Source: Saul, 1990

The effects of changing the numbers of animals, taking into consideration different mortality levels during searching (0.00-0.08) on vectorial capacity, sporozoite rates and other parameters are shown in Fig. 5. The outcomes range from a marked decrease in most of the output parameters of transmission (e.g. vectorial capacity) to an enhancement (e.g. survival rate). Because of increased opportunities to feed provided by the introduced animals, the vectors' survival rate increases and this allows the sporozoite rate to increase - a somewhat paradoxical situation. Saul's model stresses that increasing the relative numbers of animals in the hope of achieving zooprophylaxis could have unexpected effects on disease transmission.

These models, especially the ones developed by Saul and by Sota & Mogi, help identify the possible outcomes of introducing or increasing livestock in disease-endemic areas. There is, however, a dearth of epidemiological data and the next step would seem to be to test simulation models by field experiments, and wherever possible improve existing models by introducing some heterogeneity into them.

9. CONCLUSIONS

(1) The Panel recognized the desirability of integrating livestock into agricultural development schemes to increase local availability of protein and to improve the socioeconomic status of the people. But it was realized that their introduction into irrigation projects and wetland areas can have adverse as well as beneficial consequences on vector-borne diseases of public health importance.

(2) Introduction or intensification of livestock in an area must not result in increasing transmission of vector-borne diseases to humans or cause veterinary or agricultural problems, including overstocking. Care must be taken that neither livestock promotion nor vector control operations cause organic or pesticide pollution of the environment and deterioration of water quality.

(3) The Panel recognized that the presence of livestock may result in decreasing biting by vectors on people, and under certain conditions this could lead to reduced disease transmission. This has led to the idea of zooprophylaxis, especially as a control measure against malaria. Bovids are often the most suitable animals for zooprophylaxis because they are usually dead-end hosts for parasites, but not of course for *Schistosoma japonicum* and some arboviruses. There are very few well-documented cases, however, where the value of zooprophylaxis has been proved.

(4) On the other hand, there also needs to be caution that the presence of livestock does not increase populations of vectors, either by providing extra food sources for adults - that is, blood-meals - or by creating additional breeding places, such as water-filled cattle hoofprints and watering holes, for mosquito larvae.

(5) Care is needed when livestock is used for zooprophylaxis against a target disease to ensure that it does not promote conditions for enhanced transmission of other human or livestock diseases.

(6) Zooprophylaxis should be regarded as one of many methods that can be directed at disease control, and therefore should be fully integrated into existing or proposed control operations.

(7) The Panel recognized that predicting the possible changes resulting from the introduction of livestock is complicated. Although recently developed computer simulation models can give guidance to the possible outcomes, it remains essential to collect reliable ecological and epidemiological field data. Moreover, existing models need to be improved, and it seems essential that the effect of heterogeneity be included so that real-life situations are more realistically modelled.

(8) The importance of local ecological conditions, such as (i) topography, (ii) wind speed and duration, (iii) siting and spatial distribution of livestock in relation to vector breeding places and human habitations, (iv) the relative numbers of livestock to man and any animal reservoir or amplifying hosts, (v) dispersal rates of vectors, (vi) their host preferences and foraging behaviours, and (vii) survival rates of vectors, are of paramount importance in understanding the dynamics of disease transmission.

10. RECOMMENDATIONS

Further to the above conclusions, the Panel formulated specific recommendations regarding livestock development and disease vector control in irrigation projects and wetland areas.

(1) Participating United Nations agencies should collaborate in the development of strategies for the integration of livestock management into irrigation and wetland areas with full consideration for sound environmental principles.

(2) Furthermore, participating United Nations agencies should actively encourage government-financing agencies to increase intersectoral and interdisciplinary collaboration when promoting sustainable livestock management programmes in areas of wetland and irrigation.

(3) Livestock development plans should incorporate rapid assessments of human health risks and an environmental impact assessment.

(4) These assessments, developed through intersectoral collaboration, should address human health and environmental risks by developing strategies to prevent potential hazards and to encourage potential benefits, such as by:

(a) paying attention to the location of livestock in relation to human settlements and houses to maximize beneficial effects that livestock may have on human disease transmission, and also to minimize any adverse effects;

(b) recognizing that integration of livestock in or near human settlements may reduce vector-host interaction and provide zooprophylactic protection to the human population against vector-borne diseases, especially malaria.

(5) To enable countries to develop these strategies, PEEM recommends that field evaluations be undertaken to determine the cost-effectiveness and cost-efficacy of livestock in reducing vector-people contact and its impact on the epidemiology of vector-borne diseases.

11. WORKING PAPERS PRESENTED DURING THE TECHNICAL DISCUSSION

1. Timon, V. M. Policies for the advancement of livestock in land and water development projects (PEEM/WP/10/90.1).

2. Hansen, J. W., Marchot, P. & Hursey, B. Impact of livestock production on vector-borne diseases in irrigated and wetland areas (PEEM/WP/10/90.2).

3. Mogi, M. Livestock management towards Japanese encephalitis control: potential and limitations (PEEM/WP/10/90.3).

4. Kay, B. H. Case studies of arthropod-borne disease in relation to livestock (PEEM/

WP/10/90.4).

5. Carnevale, P. & Mouchet, J. The role of livestock in vector-borne disease epidemiology in Africa (PEEM/WP/10/90.5).

6. Bucher, E. H. & Toledo, C. S. Livestock management and Chagas vector control in the Gran Chaco of Argentina (PEEM/WP/10/90.6).

7. Saul, A. A computer model of the role of alternative bloodmeal sources in vector-borne disease transmission (PEEM/WP/10/90.7).

8. Service, M. W. Livestock management and disease vector control; concluding remarks (PEEM/WP/10/90.8).

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NINTH ANNUAL MEETING

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OPENING CEREMONY

The ninth meeting of the WHO/FAO/UNEP Panel of Experts on Environmental Management for Vector Control was held at the headquarters of the World Health Organization, Geneva, from 11 to 15 September 1989.

In his opening address on behalf of the Director-General of WHO, Dr T. Bektimirov, Assistant Director-General, referred to the enhanced status and significance of the collaboration between WHO, FAO and UNEP in the promotion of environmental management for vector control, in the wake of the increased awareness of global environmental problems. At the forty-second World Health Assembly in May 1989 the Director-General of WHO had highlighted the effects of environmental degradation on health and had appealed for solidarity in resolving these problems. He had emphasized the inflexibility of traditional organizational structures and had called on health ministries to play a more affirmative role in establishing and defending health policy as part of developmental and environmental protection policy in a changing world.

Recent trends in the world malaria situation showed that, whereas the overall malaria situation had not changed to any considerable degree, 34% of the world's population lived in areas where transmission was unstable or deteriorating. Areas under this category included zones where new problems had developed following major ecological or social changes, such as agricultural or other economic exploitation of jungle areas, and socio-political unrest.

Similarly, Japanese encephalitis, with its high mortality rate and often severe mental health consequences for those who survived acute infection, was on the increase as a public health problem in countries of the Western Pacific and South East Asia Regions, where flooded rice cultivation was being introduced or intensified.

Experience with these and other diseases underlined the need for a multidisciplinary and intersectoral forum to seek contributions from all sectors in the areas of prevention and control. PEEM provided such a forum and would continue to receive WHO's support. This year's technical discussions were expected to produce recommendations on how health interests could best be incorporated into broader environmental policies, and what research was needed to assist Member States in reformulating of sectoral policies so as to include a health component.

On behalf of FAO, Mr S. Scott mentioned a number of the Panel's accomplishments over the past few years which had had a tangible effect on the awareness of professionals from a range of disciplinary backgrounds. His Organization was pleased with the Panel's recent emphasis on more field-oriented activities, but this required the clear definition of mechanisms for operation through the participating agencies, and the generation of extra-budgetary funds.

Sustainable development was one of the priority areas of FAO's 1990-1991 programme of work, and for the Land and Water Division this meant an emphasis on sustainable water use and on the impact of climatic change. As a first step in the establishment of a new inter-agency programme to promote more efficient and environmentally sound water resources development projects in the 1990s, the preparation of a system-wide

United Nations document on this issue had started. FAO would continue to call attention to the health aspects of such development, as this constituted an essential element of sustainability.

Dr B.G. Waiyaki, addressing the Panel on behalf of the Executive Director of UNEP, said that human health was one of eight areas that UNEP should concentrate on during the period 1990-1995, when the second System-wide Medium Term Environment Programme would be in force. Preparations had been initiated within all United Nations agencies for the 1992 United Nations Conference on Environment and Development, and PEEM's participation in the preliminary discussions was considered very important.

The FAO/UNEP Expert Panel on Integrated Pest Management would meet in October, and this was another important occasion on which PEEM could establish effective links. There was also hope that the Zambesi Action Plan would attract support for water projects, in which PEEM could play a role in connection with the health aspects.

1. REVIEW OF ACTIVITIES, 1988/1989

1.1. Promotion

Publications. The report of the eighth annual Panel meeting had been published in early 1989, and the Panel welcomed the improved lay-out of the technical discussion section. Other publications during the period under review included selected working papers prepared for the third, fourth, fifth and sixth PEEM meetings (VBC/87.3), the IRRI/PEEM/USDA workshop proceedings *Vector-borne disease control in humans through rice-ecosystem management* and two assignment reports on the feasibility tests of the forecasting guidelines in Thailand and Malaysia (VBC/89.2 and VBC/89.3, respectively).

The need to revive the PEEM Newsletter was stressed. This publication had the widest distribution of all and was the Panel's prime public relations vehicle, covering a wide - in part non-technical - audience. Its regular appearance was considered crucial, with a minimum frequency of once every six months. Regularity was thought to be more important than the quality of presentation. There was agreement that the newsletter character of this publication should be retained and that it should not turn into a technical publication. Cost-estimates for a number of alternatives for its continued production were presented by the secretariat, and a number of Panel members made suggestions to reduce costs by producing the Newsletter in their country or region. It was decided that the secretariat would explore the viability of these suggestions, and prepare a more detailed proposal which could serve to obtain extra-budgetary funds.

Of the three guidelines under preparation, the Panel was informed of the next stages of the workplan for the guidelines for cost-effectiveness studies of vector control operations: visits to India and Ethiopia to collect case study material. The first two guidelines would be published shortly and the representative of the WHO Regional Office for the Americas offered PAHO's collaboration in preparing a Spanish version of these.

The revised publications programme was approved. The Panel made two additions to the publications programme: first, it asked the secretariat to publish an updated version of the background paper prepared for the technical discussion, and secondly it proposed the preparation of a briefing package for bilateral and multilateral agencies, containing information on the Panel's work and some key documents.

Other promotional activities. Following the eighth Panel meeting in Nairobi (5-9 September 1988) a national seminar on water resources development and vector-borne diseases had been held in Kisumu. Seventeen national participants representing four public sectors and three development authorities had been joined by seven Panel members. Proceedings of this seminar, with recommendations on how to improve intersectoral collaboration in Kenya, would be published shortly.

Contacts with other organizations. Following the review by the Panel at its eighth meeting of the report of the World Commission on Environment and Development (WCED) and of the Zambesi Action Plan, attention had been drawn to the recommendations made by the Panel in correspondence between the Chairman and the Executive Heads. As it appeared that further progress in connection with the Zambesi Action Plan

was unlikely at this stage, the Panel asked the secretariat to continue contacts with the Centre for Our Common Future (WCED's successor) and explore possibilities for PEEM's inputs into the United Nations Conference on Environment and Development.

Two Panel members were involved in the coordination of networks under the Cairo Programme of African Ministers of the Environment: Dr Abu-Zied (Egypt) coordinated the water resources network and Professor Imevbore (Nigeria) the education and training network. These networks should be used to promote issues related to environmental management for vector control.

In early 1989 the Secretary established contacts with the working group on an International Commission on Environmental Assessment (ICEA) which had been established by the Dutch Ministry for the Environment, in response to a recommendation by the World Commission on Environment and Development to establish an international and independent body which could advise on and review impact assessments of development projects. The Secretary-General of this working group, Dr I. Waddington, introduced the objectives and scope of the proposed ICEA. In the current pilot phase a number of environmental impact assessments were being carried out, and on the basis of that experience a recommendation would be made to the Dutch authorities whether or not to proceed with the establishment of such an International Commission. The health dimension of environmental assessments would certainly need strengthening, and the ensuing discussion resulted in the Panel requesting the secretariat to maintain contact with the working group and explore, at the appropriate time, whether collaboration between ICEA and PEEM could be initiated.

The representative of the United Nations Centre for Human Settlements (Habitat) briefly introduced his agency which had its headquarters in Nairobi. Through its technical cooperation division, Habitat was involved in some 270 projects in 70 countries. Many of these dealt with safe water supply, thdisposal of solid waste, surface drainage in the urban environment and other sanitation aspects of human settlements. Habitat's interest in closer collaboration with PEEM had been expressed on previous occasions and it seemed timely to make a formal approach at the appropriate administrative levels to facilitate increased cooperation.

Various collaborating centre representatives reported on the PEEM related activities of their institutions over the past year; similarly, a number of Panel members reported on their individual efforts to promote PEEM recommendations in their country or region. The Panel noted these reports with satisfaction

1.2 Research activities

· ***Azolla* research in China**. Preliminary results from Professor Lu Bao Lin's work in Hunan and Jiangsu suggested that reductions in densities of *Culex tritaeniorhynchus* activities could be achieved by introducing *Azolla* in flooded rice fields, but not of *Anopheles sinensis*. Considering the small numbers of adults emerging from both experimental and control plots, however, the differences found were not statistically significant. Research would be continued in the next cropping season.

· **Research strengthening at the Centre for Research in Medical Entomology (CRME) Madurai**. As a result of a visit by the Secretary and the Chairman of the Panel to CRME

in November 1988, a proposal for the strengthening of the Centre'sresearch in three specific areas was now under consideration at WHO: the use of neem products for the control of *Culex tritaeniorhynchus*; the effects of *Azolla* use on rice field vector breeding; and the development of water management practices that contribute to a reduction in rice field vector breeding.

· **Collaboration with the International Rice Research Institute** in establishing a research programme on rice-ecosystem management for disease vector control. The Panel was informed of recent changes in IRRI's strategy for the 1990s and formulated the terms of reference for a PEEM consultants mission to IRRI (see annex 2). This activity was included in the programme of work for 1989/1990.

1.3 Training activities

· **Visual training aids**. The slide set on environmental management for vector control had become available from WHO's Distribution and Sales in May 1989[1]. It contained 91 slides, 25 overhead transparencies and an accompanying text.

· **Proposed curriculum/syllabus**. The proposed curriculum/syllabus on disease vector management in water resources development projects for inclusion in regular engineering courses was field tested in Pakistan, India, Sudan, Kenya and Ghana, and final reports were expected before the next Panel meeting.

2. REPORT OF THE STEERING COMMITTEE

The Steering Committee held its 12th meeting in Moscow, on 20 and 21 April 1989. Its agenda included: a review of progress in the implementation of the Panel's programme of work; the status of the Panel's examination of the report of the World Commission on Environment and Development, the Zambesi Action Plan and the Cairo Programme of African Ministers of the Environment; and an update on outstanding Panel recommendations, particularly those that needed further follow-up.

The Steering Committee recommended, inter alia, that cost estimates should be prepared for the various options for continuing the newsletter; that certain components of the programme of work where no progress had been made should cease to be reported on; that a team of consultants should visit IRRI to assess the situation with respect to research on rice ecosystem management for disease vector control; and that contacts with the UNDP should be pursued through the ACC sub-committee on water resources.

Two specific matters received the Steering Committee's special attention: the Guinea worm eradication programme, and the field orientation of the Panel's programme of work.

With respect to Guinea worm infection, a major effort was under way to eliminate this disease as a public health problem during the 1990s. A number of organizations were involved in this activity, including UNICEF, UNDP, WHO, Global 2000 (the Jimmy Carter Foundation), CDC Atlanta and USAID. The Steering Committee raised the questions of whether and how PEEM could become involved in these activities. The Steering Committee felt that the area relevant to PEEM was limited to technical cooperation in the

[1] The price of the slide set Environmental Management for Vector Control is US$110, and a 30% discount applies for orders from developing countries. For further information on this and other visual training aids write to WHO, Distribution and Sales, 1211 Geneva 27, Switserland.

identification and elimination of persistent water bodies that continued to be transmission foci. This disease was of particular interest to the agricultural sector because of its substantial negative effect on agricultural production. The Steering Committee recommended that the Panel should express its interest to the participating agencies and await guidance on how it could contribute.

To increase field orientation, the Steering Committee recommended that the Panel should prepare a broad package of activities for which external support could be sought. Rather than organizing a donor meeting, the Panel should submit proposals for field oriented activities through the channels at the disposal of each of the participating agencies. This programme should be finalized at the tenth meeting of the Panel in 1990.

The Panel agreed with the conclusions and recommendations of the Steering Committee on the above and other (administrative) issues, and endorsed them for further follow-up by the secretariat.

3. PROGRAMME OF WORK 1989/1990

3.1 Programme of recommended activities

Annual meeting of the Panel. To celebrate the forthcoming tenth meeting, the Panel asked the secretariat to explore possibilities for a ceremonial opening with one or two keynote speakers. The names of Dr Swaminathan and Mrs Brundtland were mentioned. While the past decade of PEEM could be evaluated, the meeting should generally be forward looking and address issues likely to be of importance in the next decade: sustainable development and field orientation in the Panel's programme of work. With such a full agenda, there would not be enough time for an extensive technical discussion, but decisions on that agenda item would be left to the Steering Committee and secretariat, once the exact programme for the meeting had been fixed. It was decided to hold the tenth Panel meeting at the headquarters of the Food and Agriculture Organization of the United Nations in Rome, from 3 to 7 September 1990.

Fourteenth Steering Committee meeting. A decision on the organization of a mid-term meeting of the Steering Committee would be made by the secretariat in consultation with the Chairman of the Steering Committee.

Consultants mission to the International Rice Research Institute. A visit to IRRI by a team of two consultants was scheduled for March 1990, with the objective of exploring possibilities of implementing collaborative research efforts as recommended by the 1987 workshop. The terms of reference for this mission are attached as annex 2.

PEEM publications programme. A number of technical publications were scheduled: the guidelines for the incorporation of health safeguards into irrigation projects through intersectoral cooperation and the guidelines for forecasting the vector-borne disease implications of water resources development projects.

The next draft of the guidelines for cost-effectiveness studies of vector control programmes would be developed. Other scheduled promotional publications were: the case studies document, a manual on environmental management for agricultural extension

workers, and the proceedings of the Kisumu seminar. A reactivation of the PEEM Newsletter was also envisaged in the publications programme.

Training materials. The preparation of visual aids on agricultural development and vector-borne diseases was carried over from the previous programme of work, and new items included the preparation of problem-based learning packages on incorporating safeguards for vector-borne disease control into the planning process of water resources development, and the development of briefing packages for bilateral and multilateral agencies.

3.2 Estimated budget summary

	US$
(a) Organization of the tenth PEEM meeting	52 500
(b) Organization of the fourteenth Steering Committee meeting	7 500
(c) Secretariat meetings	-
(d) Consultants for IRRI	11 000
(e) Technical and promotional publications	70 000
(f) PEEM Newsletter	25 000
(g) Preparation visual training aids	10 000
(h) Preparation problem-based learning packages	7 500
(i) Assembly briefing packages	5 000
(j) Strengthening secretariat	25 000
Total	213 500

Items (a) and (b) will be covered from the regular contributions by WHO, FAO and UNEP. The remaining items will have to be covered from additional contributions by the organizations or from support from external agencies.

TENTH ANNUAL MEETING

LIST OF INVITED MEMBERS AND OTHER PARTICIPANTS

Members

Dr M.H. Birley
Lecturer, Department of Medical Entomology, Liverpool School of Tropical Medicine, Liverpool, UK

Professor D.J. Bradley
Department of Epidemiology and Population Sciences, London School of Hygiene and Tropical Medicine, London, UK

Professor A.M.A. Imevbore (Chairman)
Director, Institute of Ecology, Obafemi Awolowo University, Ile-Ife, Nigeria

Dr B.H. Kay
Chairman: Parasitology/Entomology, Queensland Institute of Medical Research, Brisbane, Australia

Professor W.L. Kilama
Director-General, National Institute for Medical Research, Dar-es-Salaam, Tanzania

Dr A.M. Michael
former Director, Indian Agricultural Research Institute, New Delhi, India

Dr M. Mogi
Chief, Division of Parasitology, Department of Microbiology, Saga Medical School, Saga, Japan

Professor J.K. Olson (Vice-Chairman)
Director, Riceland Mosquito Management Program, Department of Entomology, Texas A & M University, College Station, Texas, USA

Mrs G.L. Peralta
Assistant Professor of Environmental Engineering, National Engineering Center, University of the Philippines, Diliman, Quezon City, Philippines

Temporary advisers

Dr D. Bottrell
Consortium for International Crop Protection, College Park, Maryland, USA

Dr M. Service
Department of Medical Entomology, Liverpool School of Tropical Medicine, Liverpool, UK

Representatives of other organizations

Mr C. Abernethy
Director of Programmes, International Irrigation Management Institute, Rajagiriya via Colombo, Sri Lanka

Dr Paolo Buri
Senior Expert, National Committee for Italy, International Commission on Irrigation and Drainage (ICID), Rome, Italy

Dr D. Cuisance
Chief Veterinary Inspector, Institut d'Elevage et de Medecine Veterinaire des Pays Tropicaux, Maisons-Alfort, France

Ms J. Johnson
AAAS Science, Engineering and Diplomacy Fellow, USAID, Washington D.C., USA

Mr A. Nikiforov
Observer of the USSR to FAO, and First Secretary of the Embassy of the USSR in Italy, Rome, Italy

Dr N. Ornbjerg Christensen
Director, Danish Bilharziasis Laboratory, Charlottenlund, Denmark

Secretariat

Mr R. Bos (Secretary)
Scientist, Community Water Supply and Sanitation Unit, Division of Environmental Health, World Health Organization, Geneva, Switzerland

Dr A.M. El-Zoobi
Agricultural Extension and Training Specialist, Human Resources, Institutions and Agrarian Reform Division, Food and Agriculture Organization of the United Nations, Rome, Italy

Mr J.W. Hansen
Animal Health Officer (Helminthologist), Animal Production and Health Division, Food and Agriculture Organization of the United Nations, Rome, Italy

Dr I. Hespanhol
Sanitary Engineer, Community Water Supply and Sanitation Unit, Division of Environmental Health, World Health Organization, Geneva, Switzerland

Mr G.M. Higgins
Director, Land and Water Development Division, Food and Agriculture Organization of the United Nations, Rome, Italy

Mr A. Kandiah
Technical Officer, Water Resources, Development and Management Service, Food and Agriculture Organization of the United Nations, Rome, Italy

Dr F.J. Lopez-Antunano,
Coordinator, HPT, Pan-American Health Organization, WHO Regional Office for the Americas, Washington D.C., USA

Mr P. Marchot
Animal Health Officer, Tsetse Area Development, Animal Production and Health Division, Food and Agriculture Organization of the United Nations, Rome, Italy

Mr Swayne Scott
Chief, Water Resources, Development and Management Service, Food and Agriculture Organization of the United Nations, Rome, Italy

Mr V. Timon
Senior Officer, Livestock Production Systems Group, Animal Production and Health Division, Food and Agriculture Organization of the United Nations, Rome, Italy

Dr R. Velayudhan
Associate Professional Officer, Community Water Supply and Sanitation Unit, Division of Environmental Health, World Health Organization, Geneva, Switzerland

Dr B.G. Waiyaki
Programme Officer, Environmental Management Service, United Nations Environment Programme, Nairobi, Kenya

Unable to attend

Dr M. Abu-Zeid
Chairman, Water Research Center, Ministry of Public Works and Water Resources, Cairo, Egypt

Dr A.K. Biswas
President, International Water Resources Association, Oxford, UK

Dr R.H. Brooks
Manager, Water Resources, Tennessee Valley Authority, Knoxville, Tennessee, USA

Dr P. Carnevale
Chief, Medical Entomology Section, Antenne ORSTOM auprès de l'OCEAC, Yaoundé, Cameroon

Mr Fekade Tsegaye
Head, Public and Environmental Health Unit, Ethiopian Valleys Development Studies Authority, Addis Ababa, Ethiopia

Professor Lu Bao Lin
Director, Department of Vector Biology and Control, Institute of Microbiology and Epidemiology, Beijing, People's Republic of China

Dr M. Noory
Director-General, Water and Agriculture Department in the Western Province, Jeddah, Saudi Arabia

Mr G.T. Orlob
Professor, Department of Civil Engineering, University of California, Davis, California, USA

Dr G.S. Sinnatamby
Human Settlements Officer, United Nations Centre for Human Settlements (Habitat), Nairobi, Kenya (co-opted Secretariat member)

OPENING CEREMONY

The tenth meeting of the WHO/FAO/UNEP Panel of Experts on Environmental Management for Vector Control was held at the headquarters of the Food and Agriculture Organization of the United Nations, Rome, from 3 to 7 September 1990.

In his opening address, on behalf of the Director-General of FAO, Dr Hartwig de Haen, Assistant Director-General, Agriculture Department, dwelt upon the achievements of the Panel in meeting its original objectives, as the meeting marked ten years of successful inter-agency collaboration in the field of environmental management for human health protection and promotion.

The original objectives could be broken down into four components: strengthening of collaboration between the participating United Nations agencies; strengthening of collaboration between United Nations organizations and other international and national institutions; assisting programmes and projects relating to natural resources, agricultural and health development; and promoting the use of environmental management for the control of disease vectors in projects for agricultural development and for the protection of human health and the environment.

The Panel had successfully pursued the first two objectives, albeit that its network of collaborating centres required extension to include institutes of excellence in Africa. The challenges that lay ahead for that continent included the problems PEEM had set out to resolve.

Assistance to programmes and projects had included missions to selected countries to evaluate water-borne disease problems in irrigation projects, and some financial support for limited research at the country level. PEEM would only be able to develop appropriate field-oriented activities by generating extra-budgetary funds. Such initiatives should be carefully formulated and the participating agencies should jointly approach donors and convince them of the usefulness of integrated field programmes.

FAO considered PEEM's record in the area of promotion of environmental management to be quite impressive. Among the various technical publications over the years, the recent first two issues in the PEEM Guidelines series had met with a particularly good response. There was no doubt about the extreme importance of the Panel's objectives and activities. Where human health was at risk, everything was at risk. Adequate food and a balanced nutrition were among the basic elements of good health; reinforcing the linkages between health, food and the environment was essentially what PEEM was all about.

FAO's Constitution included several elements of sustainable development, and the issue had been given top priority following publication of the report of the World Commission on Environment and Development. The Director-General of FAO had appointed Dr P. Mahler as Special Adviser and Assistant Director-General, Environment and Sustainable Development. One of the relevant initiatives led by FAO was the International Action Programme on Water and Sustainable Development, to be implemented as a ten-year programme under the ACC Inter-secretariat Group on Water Resources. This Inter-agency programme and PEEM were complementary and mechanisms should be devised to link them, while maintaining their operational independence.

On behalf of Dr Hiroshi Nakajima, the Director-General of the World Health Organization, Mr R. Bos, Scientist in WHO's Community Water Supply and Sanitation Unit (CWS) and Secretary of the Panel, also reflected on the development of the Panel over the past decade. The Panel as a tripartite interagency activity had several unique aspects, but two in particular deserved to be highlighted: the level of continued support by Panel members and collaborating centres, which had turned PEEM into a truly operational, multidisciplinary network; and the productive interactions between the participating agencies, setting a fine example of intersectoral collaboration within the United Nations system. He was pleased to announce that, as PEEM entered its second decade, a fourth United Nations body, the United Nations Centre for Human Settlement (Habitat), would formally join the other three PEEM supporting agencies.

Looking to the future, the meeting would discuss an expansion of the mandate, formulated by the Steering Committee. The new location of the Panel's secretariat in the CWS unit of WHO had properly placed water supply and sanitation among environmental management measures for human health protection. A fertile symbiosis between CWS and PEEM was foreseen for the coming years.

On behalf of the Executive Director of UNEP, Dr B.G. Waiyaki, Programme Officer, Environmental Management Service, joined the other agencies in their positive appraisal of ten years of PEEM. The Panel's efforts had had a significant impact on various aspects of UNEP's work. Technical assistance to Member States had, however, been limited and it was time for a marked change in direction. The intention to become more field oriented had to be translated into action. The change was also necessary to facilitate UNEP's continued support for the Panel. While collaboration with WHO and FAO in PEEM was listed as a separate item in the System-Wide Medium Term Programme of UNEP, ensuring continued support, there were certain administrative limitations to its further strengthening. The development of a clear-cut medium-term programme by the Panel would help overcome these limitations.

1. REVIEW OF ACTIVITIES 1989-1990

1.1. Promotion

Meetings. The Chairman opened the discussion by reporting on his participation in the PREPCOM meeting in August at UNEP, Nairobi, where the preparations for the 1992 United Nations Conference on Environment and Development had been discussed. The Secretary-General of the Conference had indicated the need for more consultancy studies. The Panel expressed its appreciation for Professor Imevbore's efforts to promote water-associated health issues on the Conference agenda and asked the Secretariat to contact the Secretary-General regarding possible PEEM contributions.

The Panel had held its ninth meeting in Geneva from 11 to 15 September 1989. (The report of the ninth meeting is included in the present document.)

Since its ninth meeting, PEEM had also been involved in a Regional Workshop on Environmental Management for Disease Vector Control, which had been organized in Lahore, Pakistan, from 7-16 October 1989, by the WHO Regional Office for the Eastern Mediterranean. Four members of the PEEM network had participated in the workshop as resource persons. The report (document WHO-EM/VBC/50-E) gave an account of interesting environmental management initiatives in Iraq, the Kingdom of Saudi Arabia and Tunisia. Two field visits had given participants the opportunity to get acquainted with research on canal lining at the Niazbeg field Station of the Lahore Irrigation Research Institute and dam modelling at the Hydraulics Research Institute in Nandipur.

Publications. The Panel expressed its satisfaction with the first two publications in the PEEM Guidelines series: *Guidelines for the Incorporation of Health Safeguards into Irrigation Schemes through Intersectoral Cooperation*, and *Guidelines for Forecasting the Vector-borne Disease Implications of Water Resources Development Projects*. It recommended that the secretariat send out a questionnaire to generate feedback from the field, and report on it to the next meeting. This survey should follow the review of the Guidelines in the various international journals to which they had been submitted. The representative of the Pan-American Health Organization reported on progress in their translation into Spanish, and the Panel asked the secretariat to expedite the publication of a Spanish version as well as to follow up with CEFIGRE, France, on the preparation of a French version.

Progress in the preparation of guidelines for cost-effectiveness analyses of vector control programmes was found satisfactory and the Panel commended the efforts by its members in India and Ghana to facilitate field visits by the authors to those countries.

The need to give the highest priority to the publication of the Newsletter as the Panel's most important promotional tool was once again stressed, and the Panel hoped that the regular contributions of UNCHS (see below) would make it financially possible for the Newsletter to re-appear as from January 1991.

A report entitled *Water Resources Development and Vector-borne Diseases in Kenya*, the proceedings of a seminar held in Kisumu in 1988, immediately after the eighth Panel meeting, had also been published. The seminar's recommendations called for suitable follow-up, and possibilities could best be explored by a local Panel member.

ILRI, the collaborating centre in Wageningen, had published *Health and Irrigation*, by J.M.V. Oomen, J. de Wolf and W. Jobin, and copies were being made available to all Panel members.

1.2. Collaborating centre status and activities

The secretariat reported on the status of designation/re-designation of collaborating centres. A list of the centres, with their addresses and heads/focal points is included in annex 1. During the year under review the Danish Bilharziasis Laboratory had expressed its interest in becoming a WHO/FAO/UNEP collaborating centre for environmental management, and this had been followed up during a visit to Copenhagen by the Secretary. The Steering Committee had accepted the proposal for this designation and the relevant procedures were underway.

A brief outline of collaborating centre activities, based on reports received and presented at the meeting is given below.

Faculty of Tropical Medicine, Mahidol University, Bangkok, Thailand

At the request of the Thai Government, the Faculty is carrying out health risk assessment surveys in the future Nam Jone Hydropower Project area in Kanchanaburi Province in western Thailand. Surveys at different times during the year focused on snail intermediate host species and malaria vectors. In collaboration with the Lower Mekong Secretariat (ESCAP) the Faculty organized a workshop (2-7 October 1989) with the objective of reviewing the public health impact of water resources development and identifying water-borne disease problems in the Lower Mekong Basin, and of exploring possibilities to establish a monitoring system for water-associated parasitic diseases in the riparian countries. It was expected that this system would become operational in Laos, Viet Nam and Thailand in 1990 in accordance with the standardized survey methods agreed on at the workshop.

Fundacao Oswaldo Cruz, Centro de Ecologia, Rio de Janeiro, Brazil

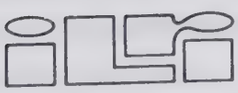
The Fundacao Oswaldo Cruz was designated as a WHO/FAO/UNEP collaborating centre in 1989. A brief review of its history shows its past involvement in key research activities in human ecology and health. Most recently it has developed environmental impact methodologies for application in Brazil, and its know-how developed during many years of ecologically oriented research is used in courses taught throughout Brazil and to students from abroad.

In 1990 a new vice-presidency was established at FIOCRUZ to coordinate all activities related to basic and applied ecology, sanitation, quality control and impact on the environment. Two diploma courses were offered (M.Sc. Parasite Biology, Ph.D. Tropical Medicine). Another training effort on health hazards is aimed at primary school teachers to reach that part of the population that never enters secondary education. A research station in the State of Santa Catarina has begun operating and will focus on the ecological relationships of bromeliad-insect-communities in an area where bromeliad-associated malaria is prevalent.

Institute for Land Improvement and Water Management, ETH, Zurich, Switzerland

A main activity of the Institute continued to be the field project in Tanzania: ''Environmental Management for Integrated Schistosomiasis Control in Namwawala, Kilombero District''. A weir, constructed upstream from a major schistosomiasis transmission focus, allows regular flushing of the seasonal river. During 1989 some 50 flushings have been carried out, increasing the run-off velocity to 1.0-1.5 m/s; the handling of the weir is carried out by a group of villagers under supervision of the District Vector Control Officer. Preliminary results show an absence of *Bulinus truncatus* and *Biomphalaria pfeifferi* in the flushed river sections, while surveys of unflushed rivers with the same characteristics show a recovery of snail populations at the end of the dry season.

The Institute has started a bibliography and reference system on environmental management for vector control in the Filemaker II format of Mackintosh. A one-day seminar on environmental management for vector control was organized as part of the annual rural and environmental engineering course. Regular contacts were maintained during 1990 with another collaborating centre, ILRI in Wageningen. Plans are under preparation for further environmental management trials in the Kilombero District, with a possible extension into urban areas (Dar-es-Salaam).



International Institute for Land Reclamation and Improvement, Wageningen, Netherlands

In June 1990 ILRI published volume 1 of *Health and Irrigation*, (mentioned above). Its ten main chapters and three technical notes provide an introduction to water-related diseases and methods for their monitoring, as well as engineering measures that can be incorporated into irrigation schemes for their control. Volume 2 containing case studies from Indonesia, Iran, Puerto Rico, Sri Lanka and Sudan had already been published in 1988.

ILRI completed its contributions to *Environmental Measures for Malaria Control in Indonesia - An Historical Review of Species Sanitation*, which catalogues 46 sites in the former Dutch East Indies where engineering and other environmental management measures were implemented. The publication will also contain four case studies: (a) early sanitation for the control of malaria in Sibolga, West Sumatra; (b) the relationship between fish ponds and malaria near Jakarta; (c) environmental management in an irrigated rice scheme near Cihea; and (d) malaria control through a house improvement project. The review is scheduled to be published early 1991.

ILRI's involvement in the production of Working Aids for Operational Irrigation System Management by the Deutsche Gesellschaft fuer Technische Zusammenarbeit (GTZ) resulted in the incorporation of a chapter on environmental management for vector control.

ILRI is ready to make a substantial contribution to PEEM's database, and in the area of training it provided lectures on environmental management for vector control in its international land drainage course and in the international course on hydraulic engineering in Delft.

Liverpool School of Tropical Medicine, Department of Medical Entomology, Liverpool, UK

Various papers were prepared during the 1989/1990 period: *Assessing the environmental health impact of water resources development* (for a special issue of the Water Quality Bulletin), five papers for the WHO Regional Workshop on Environmental Management for Disease Vector Control (Lahore, October 1989) and three papers for a WHO Informal Consultation on Information Storage and Retrieval in Vector Biology and Control (Geneva, November 1989). In October 1989, Dr Birley undertook an assignment in Pakistan to field test the concepts proposed in the forecasting guidelines. The main conclusion was that there are opportunities for important research on the effect of groundwater management on malaria vectors and malaria control.

The Liverpool School of Tropical Medicine has recently been awarded a major new funding initiative by the Overseas Development Association, and one programme within this initiative concerns the appraisal of potential health impacts of development projects. The objectives of this programme are closely linked to those of PEEM and Dr Birley urgently requests suggestions from the PEEM network for making such appraisals.

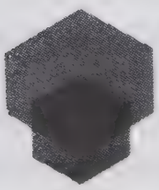
London School of Hygiene and Tropical Medicine, London, UK

The report submitted by Professor Bradley dealt with two main types of PEEM-related work at the London School: activities in any part of the School related to environmental management for vector control, and activities related more broadly to issues concerning water resources development and environmental approaches to disease and vector manage-

ment. Collaborative projects between the School and national counterparts in the area of malaria were in various phases of development in Bangladesh, Gujarat (India), Solomon Islands, Thailand and Zanzibar. In the area of schistosomiasis, work by Dr A. Jack has demonstrated in the Gambia that the ecology of transmission of *S. haematobium* determines how far intermittent treatment is an effective approach to control. Chemotherapy is inadequate on its own in those villages where transmission takes place in perennial creeks; some type of environmental management is needed as a complement.

Work on the guidelines for cost-effectiveness studies of vector control operations (with special reference to development projects) has continued in the Health Policy Unit. Field visits to India and Ghana were carried out in late 1989 and early 1990, respectively.

Professor Bradley has been invited to serve on one of the four technical Panels (the one dealing with food and agriculture) under the WHO Commission on Environment and Health, which is preparing the Organization's substantial input into the United Nations Conference on Environment and Development. He also co-authored a WHO publication which will appear before the end of 1990, *Health Impacts of Development Policies: a Bibliographic Review.*



Queensland Institute of Medical Research, Brisbane, Australia

The centre continued its long-standing technical collaboration with various local authorities in Queensland for the control of saltmarsh mosquitoes and published various papers on environmental approaches to the solution of this problem. Other relevant areas of research included evaluations of the copepod genus *Mesocyclops* for the biological control of mosquito larvae in Queensland, southern China and Brazil; the development of new surveillance methods for *Aedes aegypti*; the bionomics of the saltmarsh mosquito *Culex sitiens*; and the development of a management strategy against arthropod and parasite pests on the Ross River dam reservoir near Townsville.

The Institute organized an international symposium on Arbovirus research in Australia and included a section on environmental management aspects of arbovirus vector control. Attempts were made to establish contacts with the various federal and state departments dealing with water resources development and management, since it appears that current institutional arrangements exclude their responsibility for any health aspects involved.

In addition to various activities related to his status as a Panel member, Dr Kay undertook short term consultancies for WHO/WPRO in Viet Nam in June 1989, and in Laos in May 1990.

1.3. PEEM Information System

During the year under review the secretariat developed outlines for three databases that would make up the PEEM Information System:

· water resources developments and their health impacts

· environmental management measures in different settings

· bibliography on environmental management

The Steering Committee reviewed these outlines at its 14th meeting and made the following recommendations, that were endorsed by the Panel:

(1) The secretariat should carry out a survey, in particular in relation to the first database, of existing databases from which data could be downloaded.

(2) The first two databases should be compatible with other existing databases in the Organizations, such as the CESI (Country External Support Information) system in WHO.

(3) The third database should be in Micro-Isis which is a public domain software and allows for setting up an information exchange network with the collaborating centres.

(4) An initial step in the establishment of the first database should be to prepare information profiles of a number of countries, as this approach would make the activity more eligible for external support. The Panel agreed with the five countries selected by the secretariat for the development of such profiles: Ghana, Pakistan, Philippines, Tanzania and Venezuela.

The progress made by the Schistosomiasis Unit in WHO in the development of a geographic information system prototype for Morocco was also noted and the Secretariat was asked to strengthen PEEM collaboration in this endeavour.

1.4. Research promotion

· CRME, Madurai, India

In the period under review a Technical Services Agreement was concluded by WHO with the Centre for Research on Medical Entomology (Madurai, India) to strengthen its research on innovative riceland mosquito vector control techniques.

· *Azolla* research in China

Progress in the PEEM supported *Azolla* field trials has been delayed by exceptional climatic conditions.

· IRRI, Los Banos, Philippines

In March/April of 1990 the recommended PEEM mission to the International Rice Research Institute in Los Banos, Philippines was organized. The terms of reference for this mission had been formulated at the ninth PEEM meeting (see annex 2). The main ob-

jective was to assess the feasibility of initiating a research project on rice ecosystem management for human disease vector control. Two consultants and the Secretary had in-depth discussions with the IRRI administration and scientists and visits were made to a number of national health research institutions, the Department of Health in Manila and the WHO Regional Office for the Western Pacific.

In their final mission report, the consultants concluded that the integration of vector biology and control research activities into the new, programme-driven structure of IRRI was feasible, and that there were many possible interfaces with ongoing research programmes and subprogrammes. IRRI scientists were clearly open to collaboration whenever possible, be it data sharing, incorporation of measurements of new parameters or the overlaying of geographical data. The limiting factors to collaboration were the absence funding and lack of expertise in medical entomology and, especially, in the epidemiology of the vector-borne diseases. To obtain the necessary funding, a joint proposal should be formulated by IRRI and PEEM for submission to suitable donors. The proposal would be in support of the establishment of a disease vector research line at IRRI, thus creating a framework for research in this area both at IRRI and at its country network level.

The absence of specific scientific expertise in the medical sciences could be overcome by assigning a senior medical entomologist to IRRI. This scientist could be responsible for introducing vector research activities in the Institute, which could eventually become an integral part of IRRI's regular programme, interfacing with ongoing research programmes, and initiating and coordinating research in rice producing countries where rice associated vector-borne diseases are endemic.

Although the research activities described above would fall under the regular review and evaluation procedures of IRRI, there would also be a need for technical review and support from the public health side. This would be the responsibility of PEEM and its Panel members with specific research experience in vectors and vector-borne diseases associated with rice cultivation.

When the senior scientist had been selected and had taken up his/her post, other mechanisms for supporting research in the area should also be initiated; these should include the assignment of appropriate visiting scientists, post-doctoral fellow students or PhD students. At the country level, studies on bionomics, disease epidemiology and intervention trials should be carried out jointly by national rice research institutes and institutes of tropical medicine or ministries of health. The expertise available in the IRRI and PEEM networks should be taken advantage of in the scientific guidance of the joint activities.

The consultants recommended that their report should be submitted to the Steering Committee and to the tenth meeting of the Panel for information and review. The consultants further recommended that WHO should expedite the administrative arrangements for the re-designation of IRRI as a WHO/FAO/UNEP collaborating centre, and that PEEM should give priority to the preparation of a draft proposal for donor support and submit this to IRRI for review and inputs before seeking funding. Once agreement had been reached on the proposal, a joint strategy should be elaborated to approach potential donors.

The consultants recommended that an exchange of database information should be carried out in the near future between PEEM and IRRI on information of mutual interest related to rice cultivation and rice associated vector-borne diseases. PEEM should ar-

range for an early assignment for a period of at least one year of a senior medical entomologist to IRRI. Advantage might be taken of a scientist on sabbatical leave. When funds have been obtained for the assignment of a medical entomologist to IRRI, IRRI and PEEM should jointly proceed with his/her selection and the designation of his/her responsibilities.

The Panel reviewed the report and commended the consultants on their efforts. It especially acknowledged the support given by the two Panel members in the Philippines, Mrs Peralta and Dr Bhuiyan. The report with its conclusions and recommendations was accepted by the Panel.

Following the endorsement of the report's recommendations by the Steering Committee in June 1990, they had been followed up to prepare for the next phase. Professor Olson and Dr Bottrell (the incoming Director of IRRI's Division of Entomology) reported on this follow-up which had resulted in the in-principle proposal to make a joint IRRI/PEEM/VBC II (USAID)/Texas A&M effort to station the former as a visiting scientist at IRRI to develop a detailed proposal as mentioned in the conclusions and recommendations. A small working party met and worked out the details of this proposal. This was presented to the Panel, endorsed, and is attached as annex 3[1].

· IIMI, Colombo, Sri Lanka

Subsequent to the PEEM mission to IRRI and the presentation of its report, the International Irrigation Management Institute in Sri Lanka expressed interest in a PEEM mission to IIMI to carry out an assessment which could lead to the incorporation of a health component in its research programme. During the meeting, terms of reference were drafted for such a mission, submitted to the Panel and approved. They are attached as annex 4, and the mission to IIMI was included as an item in the Panel's Programme of Work 1990/1991.

1.5. Promotion of training

The outgoing Chairman of the Panel, Dr B.H. Kay, had prepared an analysis of the results of the field testing of the proposed curriculum/syllabus, originally developed at an informal consultation at Silsoe College, UK. The five institutions involved in the field testing were: (1) School of Engineering, University of Science and Technology, Kumasi, Ghana; (2) Faculty of Engineering, University of Khartoum, Sudan; (3) All-India Institute of Hygiene and Public Health, Calcutta, India; (4) Department of Civil Engineering, University of Nairobi, Kenya; and, (5) Centre of Excellence in Water Resource Engineering, University of Engineering and Technology, Lahore, Pakistan. The analysis included the outcome of an earlier test by Anna University, Madras, on the incorporation of an environmental management component in regular engineering courses.

In summary, Dr Kay concluded that it seemed obvious from the trials that each engineering institution would incorporate health-related material into courses in its own way. Subject matter was taught at a range of levels, from first year undergraduates to Master's level students. Given the provision of adequate literature by PEEM, such bodies were fully capable of producing competent manuals for student instruction. He recommended that PEEM continue to foster this approach to gain expanded coverage of health aspects in

[1]Professor Olson had to come back on this commitment in November 1990 because of unforeseen circumstances, and it was decided to have the PEEM secretary carry out this assigment in the 1991/1992 period; this change is reflected in annex 3.

water resources development through provision of appropriate literature and audio-visual training aids. Because the existing course programmes of engineering schools leave little room for substantial expansion, the development of a ten-hour lecture manual of a loose-leaf format might be appropriate for wider distribution. Case studies provided therein should be country or continent specific.

The Panel concurred with these views, particularly that a guideline for the incorporation of an environmental management component in engineering courses should be versatile and flexible, and that material to be used should be presented in a loose-leaf format that would allow adaptation to local conditions and facilitate photocopying for the preparation of hand-outs. As for the contents, more emphasis was needed on epidemiology that would relate disease situations to specific environmental risk factors and ecosystems.

The Panel recommended that as a follow up to this activity a loose-leaf syllabus should be developed, into which regional or country case studies could be inserted, to be supported by PEEM visual training aids. The syllabus should aim at providing sufficient material for a ten-hour course.

1.6. Contacts with other organizations

The secretariat reported on progress made in contacts with the United Nations Centre for Human Settlements (Habitat) and announced that a confirmation had now been received that it would joint WHO, FAO and UNEP as a PEEM Participating Organization as from 1 January 1991.

The Panel warmly welcomed this development and bore it in mind when discussing the proposed expanded mandate of the Panel.

Other contacts in the period under review had been with the working group on an international commission on environmental impact assessment (further developments towards formal establishment were awaited), the OECD/DAC Working Party on the Environment (PEEM would be presented at the Working Party's meeting in October 1990), the interim Committee for Coordination of Investigations of the Lower Mekong Basin and the secretariat of the International Programme for Research and Development on Irrigation and Drainage Technology (IPTRID). The latter, a World Bank/UNDP/ICID initiative, aimed to promote research in three areas: modernizing irrigation and drainage systems; ensuring sustainable water use; and improving technology for maintenance. It focused on two priority areas for action: human resources development and networking. Dr Hespanhol of the CWS Unit of WHO reported on the development of this contact, and a proposal to include mechanisms for technical cooperation between PEEM and the programme was reviewed.

PEEM could offer the expertise of its network of multidisciplinary Panel members, collaborating centres and WHO, FAO and UNEP secretariat members. This expertise included, within the broad framework of environmental management for vector control, such areas as forecasting vector-borne disease problems of water resources development, environmental engineering, waste-water use, agricultural and managerial approaches to the prevention and mitigation of irrigation-associated vector-borne disease problems, economic and financial aspects of these approaches, specific multi-disciplinary education and

training needs, and policy requirements to ensure the incorporation of health safeguards into water resources development projects.

In practical terms, it was proposed that PEEM actively collaborate with IPTRID in the development of region- and country-specific R&D agendas and of theme-based R&D projects. The expertise of the Panel would be used, whenever appropriate, for the review of proposals currently under development for Egypt, Mexico, Morocco and Pakistan. Panel members, staff of collaborating centres and secretariat members might participate in consultancy missions for the development of country-specific research proposals. The World Bank/UNDP would bring the health dimension of irrigation and drainage research to the attention of national authorities by disseminating relevant PEEM publications. It was also proposed that the World Bank, UNDP, WHO, FAO and UNEP consider the organization of a workshop on research and training needs in the field of irrigation and drainage technology in support of the human health status in developing countries.

The mechanisms for the proposed collaboration related to the networking function contained in the World Bank/UNDP initiative. The PEEM network would simply link up with the irrigation and drainage research network. To facilitate this, it was proposed that:

- the PEEM secretariat would be co-opted as part of the IPTRID secretariat, with the special mandate to cover the environmental health aspects of the programme;

- an *ad hoc* committee of Panel members be established to assist in the irrigation and drainage proposal formulation and to review tasks for country or regional research projects;

- a member of the PEEM secretariat be invited to participate in theIPTRID secretariat meetings.

The Panel endorsed these proposals and asked the secretariat to actively follow up this matter.

2. REPORT OF THE STEERING COMMITTEE

The Steering Committee had met twice since the previous Panel meeting, holding its 13th meeting in Geneva on 10 September 1989 and its 14th meeting in Geneva from 25 to 27 June 1990. The discussions at the mid-term meeting had focused on the expansion of the Panel's mandate, and a proposal presented to the Panel was subsequently endorsed (see section 3 below).

The two-year period of designation of the Steering Committee ended in September 1990, and in accordance with the terms of reference, two members, Professor D.J. Bradley and Dr S.I. Bhuiyan, had to step down having completed two periods of two years as part of the Committee. The Panel approved a proposal by the secretariat to re-appoint Dr B.H. Kay and Professor Olson for a second two-year period, and to appoint Mrs G.L. Peralta and Dr M. Abu Zeid. Professor A.M.A. Imevbore became an *ex officio* member in his capacity as Chairman of the Panel.

3. THE MANDATE OF PEEM

3.1. Introduction

On 14 October 1980 the Executive Heads of the World Health Organization, the Food and Agriculture Organization of the United Nations and the United Nations Environment Programme concluded a Memorandum of Understanding governing the collaboration between the three agencies in the prevention and control of water-borne and associated diseases in agricultural water development activities.

This tripartite agreement was a further step in a collaborative process that had started in January 1978 with the conclusion of three Memoranda of Understanding between WHO and FAO dealing with: prevention and control of water-borne and associated diseases in agricultural water development activities; rural water supply and agricultural development; and, wastewater use in agriculture, forestry and aquaculture.

Shortly after the tripartite memorandum took effect, formal Arrangements were agreed on by WHO, FAO and UNEP for the establishment of a joint Panel of Experts on Environmental Management for Vector Control, which was to become known as PEEM. The Arrangements stipulated the objectives, functions, membership profile, secretariat structure, meetings, chairmanship and budgeting procedures.

The Panel would soon be 10 years old. It has existed with a narrow remit and it was timely for this to be reviewed. The tripartite agreement was broader in scope than the Panel's focus on vectors; some areas were being neglected, while environmental approaches were of increasing interest. Opportunities for responding to these needs have been facilitated by a re-organization of the tropical diseases divisions in WHO at the beginning of 1990. The discussions on expanding the mandate had, furthermore, interested the United Nations Centre for Human Settlements (Habitat) in joining WHO, FAO and UNEP as a PEEM participating agency. That, in turn, had created additional possibilities for redefining the Panel's remit.

3.2 . Scope

PEEM was formally set up as an expression of the tripartite agreement as a joint Panel of Experts on Environmental Management for Vector Control with the implied continuation ''in water resources development''. The secretariat was located at WHO within the then Division of Vector Biology and Control. Because of the interests of the secretariat at that time and the close conceptual relationship between the Panel and the Blue Nile Health Project, the Panel's remit was coherent but quite restricted.

The objectives of the Panel were made explicit in the list of its functions: to review and advise on a variety of aspects of environmental management for disease vector control at all stages of projects for the development of natural resources. In practice, this has been interpreted as water resources development.

Annual meetings of the Panel have led to a series of reviews of key issues within its field of activity. Some reviews have led to substantial publications, others to more modest accounts. The Panel has also produced a series of practical guidelines for engineers and planners on the avoidance of vector-borne disease hazards.

The Panel was potentially of a large size, with members nominated by each of the participating agencies. Meetings of the Panel involved a limited number of members but still used up the greater part of the funds available. It had been found necessary to have a small steering committee which met twice yearly to plan the meetings and conferences and to assist with and promote the other work of the Panel.

In recent years there had been a move, strongly supported by an external review of the Panel, towards a field orientation. Because the Panel was neither a programme nor an agency, and had limited funds, this field orientation was necessarily relatively superficial and limited.

3.3. Limitations

The original mandate of the Panel was restricted in several aspects. It was limited in the types of socio-economic development considered, and in the method of vector control to be used: environmental management. The scope of the Panel was currently restricted not only by the area of overlap between the three agencies that supported it - the overlap between health, agriculture and environmental concerns - but also by focusing on a small part of that overlap, vector control, and by limiting consideration to environmental concepts for health and environmental methods for control. In spite of its apparent breadth involving three agencies, the Panel's perceived remit was narrow in a technical sense and focused on engineering. Although such a restricted mandate had initially been appropriate with a view to influencing agricultural water resources development at the engineering level, the limitations had outlived their utility for the following reasons.

First, the area had now been well studied and publicized in general terms. Guidelines had been prepared and published, engineers were much more aware of the issues, and the number of new issues in the field scarcely justified an annual meeting to discuss them. One need was for implementation, for specific studies of particular developments and modification of design to reduce vector- borne diseases - for detailed applications rather than broad principles alone. It was also necessary to influence those who write terms of reference and lending agencies, rather than just engineers.

Second, the area of the Panel's action did not coincide with the area of need. An engineer about to build a dam or irrigation scheme wanted (or needed) to know about all health implications and what was to be done about them, not simply vector-borne diseases. Advice was needed on all the relevant determinants of health from a single source.

Third, the Panel was a remarkable achievement in inter-agency collaboration and one of few examples of effective, tripartite collaboration in the United Nations system. It was a pity to restrict the Panel's potential to vector control. Moreover, the Panel could operate effectively over a broader field, with essentially the same costs and structure.

The Panel's mandate also had a policy dimension, with its objective to promote policies in government public sectors, in bilateral and multilateral agencies and in development banks that ensured the incorporation of environmental management measures into resource development projects as health safeguards. The Panel had addressed a target audience of planners and policy makers, and had carried out its task of promoting policy development and adjustment with increasing intensity, particularly since the publication of the report of the World Commission on Environment and Development.

As for the technical part of the Panel's remit, policy adjustments should take into account all health aspects (and their environmental determinants) of resource development, not exclusively vector-borne disease.

3.4. Proposal for a revised mandate

Based on the above considerations, the Steering Committee formulated recommendations for the revised mandate of the Panel. The Panel discussed the proposed text, made a number of modifications and endorsed the following, final version.

Proposal for a
REVISED MANDATE

Purpose and functions

1. Water resources development and utilization continue to provide substantial health hazards and vector-borne diseases continue to be a major health problem associated with resource development. The Panel is unique in that it looks at the issue in a multidisciplinary way and tries to promote intersectoral action towards the solution of problems through inter-agency cooperation. *To preserve and develop this unique position the focus should be maintained on environmental determinants of health in water resources development and management, and on environmental management for the prevention and control of water-related diseases in a sustainable manner. In this context a major thrust should continue to be on vector-borne diseases.*

2. One group of areas into which PEEM can helpfully expand concern topics referred to in the inter-agency Memoranda of Understanding: *the health aspects of waste water use for agriculture and the community water supply and sanitation component of agricultural water resources developments.*

This will be facilitated by the transfer of the PEEM Secretariat to the Environmental Health Division as part of recent WHO restructuring. Its location in the Community Water Supply and Sanitation Unit should provide support for PEEM, and PEEM in turn can assist with the implementation of the new CWS strategy for the 1990s.

3. In the past PEEM has almost exclusively dealt with water resources development in the rural setting. *It is recommended that the Panel should respond to the great urban water-associated vector-borne disease problems by promoting environmentally acceptable management for their control.*

This will be facilitated by UNCHS joining the group of participating agencies. Within WHO, the initiation of PEEM activities in the area of urban water associated health problems would be in collaboration and coordination with the programme on Rural and Urban Development and Housing (RUD) in the Division of Environmental Health.

Administrative considerations

4. In the broader context of WHO it is considered important that the PEEM secretariat maintain effective contacts with the newly established Control of Tropical Diseases Division. Proper coordination will facilitate the promotion of a more comprehensive approach towards human health status in development.

5. The Memorandum of Understanding under which PEEM was established is sufficiently comprehensive to include the expansions recommended above. Rather than completely re-writing the Arrangements for the establishment of PEEM, the necessary amendments could be agreed on in an exchange of letters at the ADG level of each of the agencies.

6. Implementation of Panel recommendations and operational PEEM activities has been limited in the past for lack of funds. As already mentioned above, a more efficient use of the funds available to the Panel could consist of reducing the frequency of Panel and Steering Committee meetings and using the funds thus made available for the promotion of field-oriented activities. This possibility or any other allowing for more financial flexibility needs further exploration within the agencies.

7. The Steering Committee and the Panel considered options for changing the name and acronym of the Panel to reflect its present and future concerns. This would require the addition of "Health" or even a change to "Resource Development and Health". On the other hand, the acronym has never referred to vector control so that the objective of the environmental management ("for vector control" or "for health") could be left implicit. The final decision on this is therefore to leave the name and acronym as they are, especially as "environmental management" has both a technical entomological and a broad everyday meaning.

8. The proposed changes are considered an immediate response to the needs as perceived at this particular time and the opportunities offered by the changes in WHO. The Steering Committee also considered the longer term evolution of the Panel, acknowledging that in this connection no recommendations and commitments could yet be made.

It had been suggested that the Panel might deal with natural resources development in its broadest sense or even man-made effects of development and their impact on human health. There were at least three matters that needed to be dealt with before these questions could be addressed. The first was to define or otherwise agree on the boundary or relationship between natural resource development and socio-economic development as a whole. The second was to reduce this to a working and workable delimitation of activities so as not to intrude on areas satisfactorily covered by other organizational arrangements. The third was to have a credible range of expertise and an established methodology to tackle the extraordinary range of issues that would be raised, as well as funding at least an order of magnitude greater than at present available to the Panel.

9. Finally, in order to give the necessary impulse to the process of field orientation, the revised mandate should lead to a change in the Panel's mode of working. A medium-term programme should be developed, covering a six-year period, with broad ultimate objectives. The Panel, through its Steering Committee, could then set specific objectives on a two-year rolling framework, and specific activities could be planned to implement Panel recommendations. Small working parties of Panel members and collaborating centre representatives should be deployed to assist in carrying out the activities and to achieve the specific objectives.

Within the main areas of promotion, research and training, focused approaches should ensure a successful implementation of the programme of work. Longer term planning would also facilitate raising of external support for specific PEEM activities.

4. PREPARATION OF MEDIUM-TERM PROGRAMME 1991-1995

In follow-up of the Steering Committee recommendation to develop a six-year medium-term programme for PEEM, the Panel considered a proposed programme for the period 1990-1995. A five-year period was foreseen for this first medium-term programme so that the Panel's cycle of programme development would coincide with that of the participating organizations starting in 1996.

The proposed medium-term programme had nine sections: (1) introduction and policy basis; (2) situation analysis; (3) objectives; (4) targets; (5) approaches; (6) activities; (7) programme management; (8) evaluation; and (9) financial arrangements.

The Panel discussed sections (3) to (6) and agreed on a final text for the objectives, the targets and the approaches. The Panel also approved the proposed text of sections (1) and (2), made recommendations with respect to the activities and asked the Secretariat to complete sections (7), (8) and (9).

The final document[1] should be the basis for the recommended field orientation of the Panel. It should be submitted to the four agencies for adoption and be used to mobilize funds for activities in three areas: (a) promotion, policy modification and technical cooperation; (b) research and development; and (c) training of various target groups.

5. PROGRAMME OF WORK 1990/1991

5.1 Next meeting of the Panel

It was decided to hold the 10th PEEM meeting at the WHO Western Pacific Regional Centre for the Promotion of Environmental Planning and Applied Studies (PEPAS) in Kuala Lumpur, Malaysia, from 21 to 25 October 1991. The selection of this venue by the Steering Committee had been made bearing in mind the increasing field orientation of the

[1] Published in July 1991: Panel of Experts on Environmental Management for Vector Control (PEEM). Medium-Term Programme 1991-1995, PEEM secretariat, WHO, Geneva, 1991, document CWS/91.7

Panel's programme. The subject of the technical discussion at the meeting would be: "Design and operation of rural and urban water management systems in support of vector-borne disease control". The secretariat was asked to explore possibilities of small working parties of Panel members to collect information and establish contact with local authorities in the region.

The organization of a mid-term Steering Committee meeting was left to the discretion of the secretariat in consultation with the Steering Committee members. It was suggested that if no mid-term Steering Committee meeting was held, the possibility should be explored of organizing a collaborating centre meeting to discuss the implementation of the medium-term programme.

5.2 Programme of recommended activities

This programme includes activities recommended by the Panel for which external financial support will need to be sought.

(a) *Participation in African Regional Seminar*

The Overseas Development Unit of Hydraulics Research (Wallingford, UK) and the Water Research Centre (Cairo, Egypt) are jointly organizing an African Seminar on Environmentally Sound Engineering Techniques for Water Resources Development. The activity is sponsored by the British Overseas Development Administration and will take place in Alexandria from 16 to 19 February 1991. The participation of three Panel members and one collaborating centre staff member to give presentations at this seminar has been arranged. PEEM support has been acknowledged in the second announcement of the seminar

(b) *National seminar in Viet Nam*

A national seminar on water resources development and vector-borne diseases is proposed to be held in Viet Nam immediately after the 11th PEEM meeting in Kuala Lumpur. The objective of the seminar will be to stimulate the intersectoral dialogue between planners and decision makers of the various public sectors and regional development bodies involved in water resources development, agriculture and health. Once the agreement in-principle of the Vietnamese authorities has been received, a detailed proposal and programme will be prepared. Collaboration and financial support will be sought from the regional offices of the participating organizations and from the Lower Mekong Committee (ESCAP). It is intended that the collaborating centre in Bangkok will also be involved in the organization of the seminar. The participation of 15 nationals, 8 Panel members and 5 secretariat members is foreseen.

The Panel decided that Bangladesh should be considered an alternative venue for the seminar should arrangements in Viet Nam prove problematic; in that case the seminar should focus on intersectoral action at the municipal level.

(c) *Two inter-regional workshops on environmental management in agricultural extension programmes*

As part of the development of a Manual on Environmental Management for Agricultural Extension Officers, two workshops on the subject are planned: one in February 1991

in Alexandria (in conjunction with the African Regional Seminar) and one in October 1991 in Bangkok (in conjunction with the eleventh PEEM meeting in Kuala Lumpur). This activity will be carried out as a collaborative effort with the USAID VBC Project which has earmarked US$ 25000 for the two workshops.

(d) *Proposal development at IRRI*

In accordance with the recommendations originating from the PEEM mission to the International Rice Research Institute and in follow-up of the action plan developed at the 14th Steering Committee meeting, Professor J.K. Olson will be stationed as a visiting scientist at IRRI for three months in early 1991. The terms of reference will emphasize the development of a detailed proposal for the establishment of a research programme at IRRI on rice ecosystem management for disease vector control. This will be a joint IRRI/VBC (USAID)/Texas A&M/RMMP/PEEM activity with financial contributions from all parties concerned.

(e) *Mission to WARDA, Côte d'Ivoire*

In their report, the members of the PEEM mission to IRRI recommend that contacts should be established between PEEM and the West Africa Rice Development Association (Bouake, Côte d'Ivoire). A joint mission to Bouake of the Panel's Chairman and Secretary is proposed to explore possibilities of collaboration with WARDA in the area of health aspects of irrigated rice production in West Africa.

(f) *Consultancy Mission to IIMI, Sri Lanka*

In consultation with the International Irrigation Management Institute, a mission will be organized to assess the possibilities of including a health component in IIMI's strategy and programme of work. As IIMI operates in a decentralized manner, visits to country bureaux in Colombo, Kathmandu and Lahore will be part of the mission. As recommended by the Steering Committee, an attempt will be made to include representatives of external support agencies amonng the consultants. The terms of reference for the mission are attached as annex 4.

(g) *Follow-up Kisumu seminar*

The proceedings of the seminar on water resources development and vector-borne diseases in Kenya (Kisumu, 11-13 September 1988) were published in August 1990. Follow-up of this activity towards implementation of the recommendations will be done through the local PEEM members and jointly with the collaborating centres in London and Liverpool.

(h) *Continued support to CRME, Madurai, India*

Strengthening of the research on innovative approaches towards the control of Japanese encephalitis vectors in irrigated rice ecosystems by the Centre for Research in Medical Entomology, Madurai, India will be continued during the 1990/1991 period. Possible expansion of this support to research on surveillance and early warning methods for Japanese encephalitis outbreaks will be explored with the collaborating centre in Brisbane.

(i) *Technical and promotional publications*

Estimates have been made of the costs involved in producing the documents included in the programme and these are presented below:

Spanish and French versions of the intersectoral collaboration and forecasting guidelines (PEEM Guidelines series nos. 1 and 2):	US$ 10 000
Guidelines for cost-effectiveness analyses; publication in the PEEM Guidelines series, 3000 copies and distribution:	US$ 10 000
PEEM introductory brochure; preparation, lay-out, printing and distribution of 2000 copies:	US$ 15 000
Position paper on the promotion of environmental management in agricultural extension programmes; lay-out, printing and distribution:	US$ 5 000
Looseleaf curriculum for engineering schools:	US$ 5 000

(j) *PEEM Information System*

At its 14th meeting, the Steering Committee recommended proceeding with the further development of the bibliographic database, initiating the other two proposed databases for a limited number of countries, and investigating which other relevant databases were available that could support the development of the databases on water resources development and health, and on environmental management.

Five countries were selected by the secretariat in which to initiate work on these two databases: Ghana, India (one State), Philippines, Tanzania and Venezuela. In addition, collaboration with the Schistosomiasis Unit in WHO/CTD will be strengthened in the area of geographic information system (GIS) development.

(k) *Visual training aids*

The format for the recommended visual training aids on agricultural development and vector-borne disease transmission was defined at the 14th Steering Committee meeting. A feasibility study on preparing training aids from slide material available in the participating organizations will be carried out. Inputs from Panel members and collaborating centres will also be sought.

(l) *Preparation of problem-based learning packages*

This activity is carried over from the 1989/1990 programme of work. The development of such packages was recommended by the Panel at its eighth meeting as being an essential tool for any future training activities.

(m) *Assembly of briefing packages*

This activity is carried over from the 1989/1990 programme of work. It follows from the 1989 technical discussion recommendations. The available PEEM material needs to be evaluated for its usefulness, some additional material should be developed, and an attractive presentation designed.

An estimated budget summary is presented on the next page.

5.3. Estimated budget summary

	US$
I. REGULAR PROGRAMME	
(a) organization of the 11th Panel meeting	60 000
(b) organization of the 16th Steering Committee meeting in 1991 (tentative)	10 000
(c) secretariat meetings	-
(d) publication of the Newsletter	10 000
II. PROGRAMME OF RECOMMENDED ACTIVITIES	
(a) participation in African Regional Seminar	10 000
(b) national seminar in Viet Nam	15 000
(c) two inter-regional workshops on environmental management in agricultural extension programmes	50 000
(d) proposal development at IRRI (preliminary estimate)	50 000
(e) mission to WARDA, Côte d'Ivoire	4 000
(f) consultancy mission to IIMI, Sri Lanka	8 000
(g) follow-up Kisumu seminar	6 000
(h) continued support to CRME, Madurai, India	10 000
(i) technical and promotional publications	45 000
(j) PEEM Information System	50 000
(k) visual training aids	8 000
(l) preparation of problem-based learning packages	7 500
(m) assembly of briefing packages	6 000
Total	349 500

Items under the Regular Programme will be covered from the regular contributions of the four participating organizations. Of the items under Recommended Activities, items (a), (g) and (h) will be covered from additional contributions by the agencies, item (j) is already covered under an existing Technical Services Agreement, and funds will be forthcoming from VBC/USAID for items (d) and (f).

ANNEX I

THE PEEM NETWORK

1. Composition of the Panel

Dr M.A. Abu-Zeid
Chairman, Water Research Centre, Ministry of Irrigation, Cairo, Egypt

Professor A.N. Alekseev
Senior Research Associate, Laboratory of Comparative and Ecological Pathology, Sechenov Institute of Evolutionary Physiology and Biochemistry, Academy of Sciences, Leningrad, USSR

Dr F.P. Amerasinghe
Visiting Professor, University of Maryland, College of Life Sciences, Department of Entomology, College Park, Maryland, United States of America

Dr S.K. Ault
Public Health Biologist, Davis, California, United States of America

Dr S.I. Bhuiyan
Agricultural Engineer, Soil and Water Sciences Division, International Rice Research Institute, Manila, Philippines

Dr M.H. Birley
Lecturer, Department of Medical Entomology, Liverpool School of Tropical Medicine, Liverpool, United Kingdom

Dr A.K. Biswas
President, International Water Resources Association, Oxford, United Kingdom

Professor D.J. Bradley
Professor of Tropical Hygiene, Department of Epidemiology and Population Sciences, London School of Hygiene and Tropical Medicine, London, United Kingdom

Dr R.H. Brooks
Director, Environmental Quality Staff, Tennessee Valley Authority, Knoxville, Tennessee, United States of America

Dr P. Carnevale
Head, Medical Entomology Section, Antenne ORSTOM auprès de l'OCEAC, Yaoundé, Cameroon

Dr A.A.M. Chaudhary
Director, Directorate of Malaria Control, Ministry of Health, Islamabad, Pakistan

Dr A.W. Choudhry
Specialist in Environmental and Occupational Health, Sahiwal, Pakistan

Dr M. Coosemans
Prince Leopold Institute of Tropical Medicine, Laboratory of Medical Entomology, Antwerp, Belgium

Dr G. Farnworth
Environmental Advisor, Inter-American Development Bank, Washington DC, United States of America

Mr Fekade Tsegaye
Head, Public and Environmental Health Unit, Ethiopian Valleys Development Studies Authority, Addis Ababa, Ethiopia

Mr D. Goe
Project Manager, Bong County Agricultural Development Project, Monrovia, Liberia

Professor A.M.A. Imevbore
Director, Institute of Ecology, Obafemi Awolowo University, Ile-Ife, Nigeria

Dr W. Jobin
Director, Blue Nile Associates, Foxboro, Massachussetts, United States of America

Professor Z. Kaczmarek
International Institute for Applied Systems Analysis (IIASA), Vienna, Austria

Mr G. Kamakula
Director, National Environmental Management Council, Dar-es-Salam, United Republic of Tanzania

Dr B.H. Kay
Chairman, Parasitology/Entomology, Queensland Institute of Medical Research, Herston, Brisbane, Australia

Mr A.I. Kathibu
National Project Director, Ministry of Agriculture, Zanzibar, United Republic of Tanzania

Professor W. Kilama
Director-General, National Institute for Medical Research, Dar-es-Salam, United Republic of Tanzania

Dr R.J.H. Kruisinga
Member of the Senate, the Hague, Netherlands

Professor E. Laing
Chairman, Health Committee on Water Resources Development, University of Ghana, Legon, Ghana

Professor Lu Bao Lin
Director, Department of Vector Biology and Control, Institute of Microbiology and Epidemiology, Beijing, People's Republic of China

Dr M.A. Madrane
Director, Centre technique de la canne à sucre, Cité ORMVAG, Bir Rami, Morocco

Dr A.M. Michael
former Director, Indian Agricultural Research Institute, New Delhi, India

Dr M. Misutani
Associate Professor, Utsonomiya University, Tochigi, Japan

Dr M. Mogi
Chief, Division of Parasitology, Department of Microbiology, Saga Medical School, Saga, Japan

Dr M. Noory
Director-General, Water and Agriculture Department in the Western Province, Jeddah, Kingdom of Saudi Arabia

Professor J.K. Olson
Director, Riceland Mosquito Management Program, Department of Entomology, Texas A&M University, College Station, Texas, United States of America

Dr G.T. Orlob
Professor, Department of Civil Engineering, University of California, Davis, California, United States of America

Mr G.E. Ortega-Gil
Coordinator Professional Development, Instituto Mexicano de Tecnologia del Agua, Xotapingo, Mexico

Dr J.H. Ouma
Head, Division of Vector-borne Diseases, Ministry of Health, Nairobi, Kenya

Dr C. Ow-Yang
Institute for Medical Research, Kuala Lumpur, Malaysia

Mrs G.L. Peralta
Professor, Environmental Engineering, University of the Philippines, Diliman, Philippines

Dr G.G. Pinter
National Project Director, National Water Authority for Pollution Control, VITUKI, Budapest, Hungary

Dr A. Rwamakuba
Directeur de l'environnement, Ministère de planification, Kigali, Rwanda

Professor Santasiri Sornmani
Faculty of Tropical Medicine, Mahidol University, Bangkok, Thailand

Dr M. Sasa
former President, Toyama Medical and Pharmaceutical University, Tokyo, Japan

Professor W.A. Schmid
Vice-president, Federal Institute of Technology, Zurich, Switzerland

Dr V. Serguiev
Director, Martsinovskij Institute of Medical Parasitology and Tropical Medicine, Moscow, USSR

Dr V.P. Sharma
Director, Malaria Research Centre, Delhi, India

Professor L.S. Small
Agricultural Economist, Cook College, Rutgers University, New Brunswick, New Jersey, United States of America

Dr P. Tauil
Parliamentary Advisor, Health Area, Federal Senate of Brazil, Brasilia, Brazil

Dr R. Zeledon
Professor, National University, Heredia, Costa Rica

2. List of Collaborating Centres

Institute for Land Improvement and Water Management
Swiss Federal Institute of Technology
ETH - Hönggerberg
8093 Zurich
Switzerland

Focal point: Mr M. Fritsch

London School of Hygiene and Tropical Medicine
Keppel Street (Gower Street)
London WC1E 7HT
United Kingdom

Dean: Professor R. Feachem
Focal point: Professor D.J. Bradley

Tennessee Valley Authority
Evans Building
Room 1W 14 1A
Knoxville, Tennessee 37902
United States of America

Director: Mr Marvin T. Runyon
Focal point: Dr R.H. Brooks

International Rice Research Institute
P.O. Box 933
Manila
Philippines

Director: Dr K. Lampe
Focal point: Dr S.I. Bhuiyan

Liverpool School of Tropical Medicine
Department of Medical Entomology
Pembroke Place
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United Kingdom

Focal point: Dr M.H. Birley

International Institute for Land Reclamation and Improvement
P.O. Box 45
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Netherlands

Director: M.J.H.P. Pinkers
Focal point: Mr W.B. Snellen

Queensland Institute of Medical Research
Bramston Terrace, Herston
Brisbane, Queensland
Australia

Focal point: Dr B.H. Kay

Oswaldo Cruz Innstitute
Rua Leopold Bulhoes, 1480
Terreo, Manguinhos
21041 Rio de Janeiro - RJ
Brazil

Vice-president and focal point: Professor F. Dias de Avila Pires

Faculty of Tropical Medicine
Mahidol University
420/6 Rajvithi Road
Bangkok 4
Thailand

Focal point: Professor Santasiri Sornmani

The International Irrigation Management Institute
51, New Parliament Road
Rajagiriya via Colombo
Sri Lanka

Director: Dr Roberto Lenton
Focal point: Mr Ch. Abernethy

Danish Bilharziasis Laboratory
Jaegersborg Allé, 1D
DK 2920 Charlottenlund
Denmark

Director and focal point: Dr N.O. Christensen

ANNEX 2

TERMS OF REFERENCE FOR THE PROPOSED MISSION TO THE INTERNATIONAL RICE RESEARCH INSTITUTE

Following are the terms of reference for the proposed visit of PEEM consultants for deliberations with the Director General and staff of the International Rice Research Institute (IRRI), Los Banos, on the nature and scope of IRRI/PEEM collaboration in the areas of research and training.

Preamble

1. This visit will take place against the background of a highly successful PEEM/IRRI workshop (Los Banos, 9-14 March 1987) on research and training needs in the field of integrated vector-borne disease control in riceland agro-ecosystems of developing countries and the set of recommendations produced by the workshop.

2. If environmental management is to be successfully used in the control of human vector-borne diseases in riceland agro-ecosystems then:

   (a) the measures proposed must be congruent with agronomic and engineering needs of successful rice production and the practices and traditions of the rice farming communities.

   (b) implementation requires action by those outside the health sector if it is to be effective and broadly applicable.

3. If it is to lead to successful action, such intersectoral cooperation requires that an investigator responsible for research on health and vector control operates within a primarily agricultural institution rather than vice-versa.

4. This is also a necessary requirement to implement many of the recommendations made by the IRRI/PEEM workshop.

5. Such collaborative work is difficult and requires careful planning if it is to be successful, especially at a time when financial constraints tend to push people towards more disciplinary conservation.

6. It has therefore been recommended by the WHO/FAO/UNEP Panel of Experts on Environmental Management for Vector Control that the PEEM secretariat, in coordination with IRRI, arranges for two experts with appropriate skills to visit IRRI, for a period of 7-10 days, with the following objectives.

Objectives

7. To determine both in principle and in practice how best to achieve collaboration between IRRI and PEEM so as to put into effect the key recommendations of the IRRI/ PEEM workshop.

8. In particular, to assess the feasibility of establishing a distinct research line within IRRI's programme, to determine where such a research line would organizationally fit into IRRI's structure, how joint action by WHO/FAO/UNEP PEEM and IRRI should be designed to obtain external funding for this activity, and to identify mechanisms by which all agencies involved could optimally provide continuous administrative and technical support to this research line.

9. To determine the detailed qualifications and experience needed for an specialist in environmental management of human disease vectors to be based at IRRI, the best way such a person could fit into the organizational structure of IRRI and the funding implications of such a proposal.

10. In accordance with the workshop recommendations to identify the likely key fields of work of such a scientist when setting up the research line and discuss possible projects, in terms of both place and topic of study.

11. To discuss possible collaborative arrangements with additional research institutions to facilitate the work and avoid professional isolation.

12. To consider the practical location of the scientist with reference to the proportion and nature of work at IRRI and in the field, and to propose practical logistical arrangements.

13. To define the practical steps for implementation and to identify a suitable funding body or bodies, and to agree the detailed manner of approaching them, together with the responsibilities of both WHO/FAO/UNEP PEEM and IRRI in the arrangements.

14. In conclusion, to draft a plan of action and an application for funds ready for submission.

15. To visit, as part of the mission, the Regional Office of WHO for the Western Pacific and such other organizations in the Philippines, international or national, as may be appropriate, including the Asian Development Bank.

16. To submit a report and a draft plan of action/funding application within four weeks of completing the visit to IRRI.

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ANNEX 3

PROPOSAL FOR THE DEVELOPMENT OF A RESEARCH PROJECT ON RICE-ECOSYSTEM MANAGEMENT FOR HUMAN DISEASE VECTOR CONTROL

BACKGROUND

In March 1987, an International Workshop on Research and Training Needs in the Field of Integrated Vector-borne Disease Control in Riceland Agro-ecosystems in Developing Countries, held at the International Rice Research Institute (IRRI), Los Banos, resulted in a comprehensive research agenda on rice-ecosystem management for human disease vector control.

The initiative for the workshop originated from IRRI, the World Health Organization, the Food and Agriculture Organization of the United Nations and the United Nations Environment Programme, through their joint Panel of Experts on Environmental Management for Vector Control (PEEM), and the USDA Riceland Mosquito Management Program.

In 1990, as a follow-up to the Workshop, PEEM sent three consultants to IRRI to determine the feasibility of defining suitable research areas on human disease vectors that would fit the current IRRI workplan. Following discussions with the IRRI administration and with IRRI scientists, the consultants prepared a report that (1) considered the incorporation of such a research project into IRRI's present programme to be feasible, and (2) included recommendations on steps to develop a detailed proposal for this project.

The PEEM secretariat subsequently explored possibilities for external support for the project development phase. The Washington D.C.-based Vector Biology and Control Project, implemented by an AID supported consultants group, indicated its interest in collaborating in this endeavour. Prospects for securing additional funds from donors to support the project's research appear to be encouraging.

The PEEM Steering Committee adopted the mission report with its conclusions and recommendations in June 1990, and the Panel, at its 10th annual meeting in Rome in September 1990, endorsed this decision.

The present proposal is based on discussions of a small working party during the 10th PEEM meeting and follow-up consultations between the PEEM secretariat, IRRI scientists and representatives of the VBC Project. It sets forth terms of reference, a timetable and other requirements for a consultant to be stationed at IRRI as a visiting scientist to develop the project plan in collaboration with IRRI scientists. It also defines a mechanism by which, at the end of the formulation process, funding arrangements can be explored and possibly initiated.

OBJECTIVES

To develop and formulate a plan for establishing a research project on rice-ecosystem management for environmental control of human disease vectors at the International Rice Research Institute.

To organize a meeting of potential donors where the project plan is presented and which will aim to secure funds for the initial five years of the project.

PARTICIPATING ENTITIES

The International Rice Research Institute, Los Banos, Philippines

The Vector Biology and Control Project (VBC) of USAID.

The joint WHO/FAO/UNEP/UNCHS Panel of Experts on Environmental Management for Vector Control, secretariat, World Health Organization, Geneva, Switzerland

The Queensland Institute of Medical Research, Brisbane, Australia

The PEEM secretariat will be the coordinating focal point for all activities contained in the present proposal.

WORKPLAN

The workplan to implement this proposal consists of three phases. During the first, **preparatory phase**, the process of formulation of multidisciplinary country project plans will be set in motion. It is foreseen that these projects will make up a substantial part of the final project plan. They are intended to be implemented through the appropriate IRRI networks, by national rice research and health research groups. This component was particularly emphasized in the 1990 PEEM mission report

As a first step, letters will be sent to key rice and health researchers in a number of Asian countries inviting them to develop and submit one or more country projects. On receipt of a positive response, minimal requirements for the format of the project plans will be conveyed. The research agenda developed at the 1987 IRRI/ PEEM workshop will serve as a guideline for the issues to be addressed and the objectives to be met.

As a second step Dr Brian H. Kay of the Queensland Institute of Medical Research (QIMR), a PEEM collaborating centre, will travel to Thailand and Indonesia to accelerate project development in those countries. Dr Kay participated in the 1987 workshop and has been closely involved in the follow-up activities. From this background he will give expert assistance in project development, in contacts with the health research groups and the IRRI country liaison scientists.

Draft country project plans will be given a rapid circulation for peer review.

For the next phase, **the three-and-a-half month assignment of a consultant**, it is proposed that Mr Robert Bos, Scientist in the Community Water Supply and Sanitation Unit and Secretary of the WHO/FAO/UNEP/ UNCHS Panel of Experts on Environmental Management for Vector Control will be stationed at the International Rice Research Institute.

Mr Bos will work at IRRI in close collaboration with the relevant IRRI scientists towards the formulation of the project plan. It should primarily relate to the development of a health component to fit within IRRI's research programme on the irrigated rice ecosystem and the mobilization of the necessary resources at IRRI, Los Banos. The research component should be integrated into IRRI's programme-driven structure and should allow for research at the Los Banos site as well as coordination and further development of country projects.

Mr Bos will visit national research groups in the Philippines, Indonesia, India and Thailand to assist in the completion of their country project plans. He will subsequently visit the Queensland Institute of Medical Research to assess possibilities for strengthening collaborative links between IRRI and QIMR under the project.

A schistosomiasis expert, Dr John Cross, will assist Mr Bos prepare sections of the project plan related to that disease. This will focus on *japonicum* and *mekongi* schistosomiasis.

The total duration of his assignment will be three-and-a-half months. Towards the end of this period, a first internal review of the preliminary project plan by the IRRI scientists will take place. Comments will be considered for incorporation into the final plan, to be prepared in the standard UNDP format.

During the second half of the assignment preparations will be finalized for the next phase, **the organization of a donor meeting** to launch the project plan. Prior to this donor meeting the text of the plan will be given a quick circulation for peer-review, among members of the PEEM and IRRI networks. A number of these will also be invited to the donor meeting as technical resource persons.

The preferred venue for the donor meeting will be the Asian Development Bank in Manila, but initially other possible venues will be explored as well. The meeting will be structured so that general introductions and the presentation of a number of multidisciplinary research experiences and their results are followed by the

presentation of the project plan and a response by the donor agencies.

TERMS OF REFERENCE

Terms of reference were formulated and approved at the 10th PEEM meeting. The following work is to be performed:

1. To prepare a framework for the research to be conducted at IRRI and by collaborating national institutions.

2. To specify components of research in specific proposals for implementation in a phased manner, based on the recommendations made at the 1987 Workshop at IRRI and discussions during the 1990 PEEM mission, covering both mosquito-borne and snail-borne diseases.

3. To identify areas of on-going work at IRRI related to PEEM priorities for integrating health considerations with agronomic practices.

4. To visit appropriate national programme staff in the Philippines, Indonesia and Thailand to determine possibilities of setting up multidisciplinary research efforts, increasing collaboration between national rice research institutes and institutes for health research, and studying the impact of agronomic practices on human disease vectors.

5. To prepare guidelines for the evaluation of the project's research accomplishments.

6. To prepare a comprehensive project plan for five years for implementation within the IRRI structure.

7. To organize a meeting of representatives of potential donors, IRRI, PEEM and VBC II representatives, to present the project plan and to determine mechanisms for funding.

TIMETABLE

The tentative dates proposed for for the three phases, and in particular for the three months consultancy assignment of Mr Bos, are presented below:

First Phase

Activity	Proposed dates
Correspondence with researchers in rice growing countries in Asia	July 1991
Regional travel by Dr Kay with visits to Thailand, Indonesia and a stop-over in Manila	August 1991
Peer review draft project proposals	October 1991

Second Phase

Activity	Proposed dates	
Consultants assignment Mr Bos		
Initial data gathering and interviews at IRRI	Last week of November, first week of December 1991	
Visit national institutes Philippines	Second week of December 1991	
Drafting proposal outline and preparations regional travel	Second half of December 1991	
Visit South India (Madurai)	five days	
Visit North India (MRC, Delhi)	five days	
Visit Thailand	eight days	4-1/2 weeks Jan. 1992
Visit Indonesia	ten days	
Travel time	five days	
Write up trip reports	First week of February 1992	
Visit to the Queensland Institute of Medical Research, Brisbane	Second week of February 1992	
Collaborative work with the schistosomiasis consultant; possible visit to endemic parts of the Philippines	Second/fourth week of February 1992	
Write-up complete draft of the project plan	Fourth week of February/first week of March 1992.	
Review by IRRI scientists, preparation second draft; and preparations for the donor meeting	First and second week of March 1992.	

Third Phase

Activity	Proposed dates
First exploratory letter to key donors concerning the possible venue	August 1991
Announcement letter to bilateral and multilateral agencies	November 1991
Invitation letter	January 1992

Circulation of the proposal	March 1992
Donor meeting	Two days early April 1992

OUTPUTS

1. Trip reports on visits to Indonesia, Thailand, India and the national institutions in the Philippines.
2. Several country project plans for multidisciplinary research.
3. A final proposal for the establishment of the project at IRRI.
4. A final assignment report for submission to VBC (USAID), PEEM and IRRI.
5. A report of the donor meeting.

ANNEX 4

TERMS OF REFERENCE FOR THE PROPOSED MISSION TO THE INTERNATIONAL IRRIGATION MANAGEMENT INSTITUTE

Following are the Terms of Reference for the proposed visit of PEEM consultants for deliberations with the Director-General and staff of the International Irrigation Management Institute (IIMI), Colombo, Sri Lanka on the nature, scope and modalities of IIMI/PEEM collaboration in the areas of research and training.

Preamble

1. Soon after the establishment of the International Irrigation Management Institute, a joint IIMI/PEEM seminar on irrigation and vector-borne disease transmission in Sri Lanka was organized.

   At the seminar areas of mutual interest to IIMI and PEEM were explored and in the conclusions/recommendations possibilities to develop a collaboration were indicated. This has led to the designation of IIMI as a WHO/FAO/UNEP collaborating centre for environmental management, the procedures for which will be completed shortly.

2. Models of irrigation management are as diverse as the ecological and social environments in which irrigation is practised. IIMI's remit is to carry out research and training which will lead to improvements in irrigation management with, as a result, an optimal and equitable use of irrigation water to ensure better outputs. Environmental and health protection and improvement are important secondary goals of irrigation management innovation.

3. Local determinants of the human health status vary to a great extent as well, and any research to be carried out in the IIMI/PEEM collaboration will have to be in the firmly based framework of local irrigation management practices and epidemiology. In this connection it is relevant to observe that IIMI has developed a decentralized structure. In the past few years it has opened country offices in the Philippines, Bangladesh, Nepal, Pakistan, Sri Lanka, Sudan and Moroccco, a regional office for West-Africa in Burkina Faso, and it maintains liaisons with India, Indonesia and Malaysia. Over the next two years it expects to initiate programmes in Latin America and in Egypt.

4. Solutions to major problems in irrigated agriculture in terms of irrigation management improvements will theoretically also have an effect on human health. Conversely, changes in irrigation management to modify vector-borne disease must also have agricultural benefits if they are to be viable. To properly research this and other issues requires that an investigator on health and disease vector control operates within a primarily agricultural institution rather than vice versa.

5. Such collaborative work is difficult and requires careful planning if it is to be successful, especially at a time when financial constraints tend to push researchers towards more disciplinary conservation.

6. It has therefore been recommended by the WHO/FAO/UNEP Panel of Experts on Environmental Management that the PEEM secretariat, in coordination with IIMI and, where needed, national authorities, arranges for two experts with appropriate skills to visit IIMI headquarters, three IIMI country offices (Sri Lanka, Pakistan and Nepal) and appropriate national institutes for a total period of 15-20 days with the following objectives:

Objectives

1. Based on IIMI's current strategic plan, to explore and determine with the IIMI headquarters staff the broad areas of collaboration between IIMI and PEEM, and how a health research component could best be fitted in IIMI's structure.

2. To discuss with IIMI staff how a specific research agenda for this component could best be defined.

3. To visit the country offices of IIMI in Nepal, Pakistan and Sri Lanka as well as the national health research institutions in those countries to assess where research on the health dimension of irrigation management could initially be established with the greatest chance of substantial and applicable results.

4. In particular, to consider the practical implications and assess the feasibility of establishing a distinct health research component in any of the country office programmes, what this would require in liaison with IIMI headquarters, how joint action by WHO/FAO/UNEP PEEM and IIMI should be designed to obtain external funding for this activity, and to identify mechanisms by which all agencies involved could optimally provide continuing administrative and technical support to the health research component.

5. To review IIMI's programme of work and to determine which on-going or planned research activities would potentially interface with research to be initiated under a health component.

6. To discuss the observations made and conclusions derived from the visits to country offices with the IIMI headquarters staff and in consultation with them draft a plan of action.

7. To define practical steps needed for its implementation and to identify a suitable funding body or bodies, and to recommend the detailed manner of approaching them together with the responsibilities of both WHO/FAO/UNEP PEEM and IIMI in the arrangements.

8. To visit, as part of the mission, the Regional Office of WHO for South East Asia Alternatively, the Regional Entomologist SEARO may be invited to participate in the mission.

9. To submit a report and draft plan of action including first drafts of at least two specific project ideas within four weeks after completing the mission to IIMI.

Special consideration:

It is proposed to explore the possibility of inviting a representative of a major donor agency to participate in the mission so as to establish early links and facilitate funding of the initial phases of the implementation of the action plan.